ENGINEERING NEWS

THE MUSCONETCONG TUNNEL is being repaired in one of the soft-ground sections about 700 ft. long. The soil was very heavy clay and the large bars used, and then withdrawn, left openings that were difficult to pack properly. The brick arch gave way at the haunches and rose at the key under the pressure and made repairs necessary. This work is now being done by Chief Engineer STEDMAN, with MICHAEL NOLAN in charge. The double tracks were switched into a single central track through the section to be repaired, and the tunnel was then timbered with three sets of 12 × 12 in. timbers, the arch being in seven segments; or lined with a timber wall 3 ft. thick. Entrance was then made through an old shaft to the top of the tunnel and a 6 x 7 ft. heading driven over the crown. This heading was widened towards the haunches and the crippled material moved down to the base of the side-walls and replaced by concrete of Portland cement, 3½ ft. thick. An invert is also being put in place. About a 20 ft. section is completed in a week.

THE WEST POINT TUNNEL repairs progress slowly, and the two loaded baggage and express cars, caught in the original fall, are said to be still buried. Steel centers are being used to secure the new work as it advances.

SMALL COMPOUND LOCOMOTIVES are to be used for hauling freight to the Paris exposition of 1889. M. DECAUVILLE, the builder of portable railway plant and equipment, has issued a circular stating that there will be about 12½ miles of track of 22.68 ins. gauge laid with rails weighing about 14 and 20 lbs. per yard. The cars will be hauled by compound engines weighing 9½ tons empty and 12 tons in working order. Over these lines will be transported the 40 ton guns which are to be exhibited by the Minister of Marine. The track will be of the Decauville system, the steel rails being riveted to steel cross-ties. A part at least of the line will be laid with the "portable" track. A small compound engine of this type was described and illustrated in ENGINEERING NEWS, Sept. 1.

THE FOLSOM DAM across the American river near Sacramento, Cal., is approaching completion, says the Sacramento *Bee*. This is a masonry dam, with a base of 60 ft., width at top of 25 ft. and it will be 69 ft. high. The dam proper is 218 ft. long, but there will be a curved wing 120 ft. long, and a straight wing 130 ft. long. The main purpose of the dam is to provide motive power for the State prison and other manufactories. About 90,000 cu. ft. of masonry are now laid up, by prison labor.

THE SAVANNAH RIVER CONVENTION, recently held at Augusta, Ga., in a committee report called renewed attention to the importance of improved navigation on this stream and found considerable fault with the National Government for its small and infrequent appropriations for that purpose. The report claimed that this river, having one-fifth of the total navigable waters above tide on the Atlantic slope, had only received nine-tenths of one per cent. of the appropriations for rivers on that slope. Civil Engineer LOUIS J. BARBOT in the course of the proceedings made an earnest appeal for improvement, and suggested that the matter of the better security and protection of the city of Augusta be turned over to the Council of Engineering Societies for advice free of any professional fees.

THE WESTINGHOUSE AND EAMES BRAKES.—The Westinghouse Air Brake Co. has sued the Eames Vacuum Brake Co., and N. W. HOWSON and ALBERT P. MASSEY, of Watertown, for infringement. It seems that for some time the Eame Brakes Co. has been manufacturing and selling a locomotive brake, which, the Westinghouse people allege, is an infringement on a device, the patent for which is owned and controlled by them. Their patent, which they claim is being infringed by the Eames Co. was framed in July, 1886, by GEO. H. POOR, of Cincinnati, and transferred to the American Brake Co., of Missouri, which corporation, in August, 1888, was merged into the Westinghouse Co. The Westinghouse Co. ask for a temporary and permanent injunction against the Eames Co., so far as this particular brake is concerned and also pray for an assessment of damages against the Eames Co., of about $30,000 in all. The complaint has been filed in the United States Court in this city, GEO. H. CHRISTY, of Pittsburg, and ALBERT BLAIR, of St. Louis, being counsel for the petitioners. The answer of the Eames Co. will probably be filed one week from Monday.—Utica (N. Y.) *Tribune*, Nov. 25.

THE CHIGNECTO SHIP RAILWAY contracts are reported to be all awarded, and actual operations commenced. As before mentioned the estimated cost is $5,000,000, and it is expected that the line can be completed by Sept. 1, 1890. According to a reported interview with Engineer KETCHUM, the transfer dock at the Bay of Fundy end will be 600 × 360 ft., and the one at Chignecto will be 800 ft. long. In the Bay of Fundy will be a dock 200 ft. long with a hydraulic lift of 40 ft. The vessels will be floated into this dock, provided with a gate, and then placed on cradles, which latter will be lifted and run upon the railway: 4 steel rails, weighing 110 lbs. per lin. yd. will form the track and under the larger vessels there will be 200 wheels. The total length of the railway is 17 miles.

A STEAM-HEATING ordinance passed the Common Council of Philadelphia on Nov. 23., permitting a local company to lay pipes in a large district of the city, but not in the central portion. The company is to pay annually 1 cent per lin. ft., or $52.80 per mile of pipe for the privilege. The company is said to be mainly made up of city politicians; hence the modest valuation put upon the privileges.

THE CHICAGO WATERWAY PROJECT, to the Mississippi *via* Joliet, is again being broached, and a meeting of interested parties is called to meet in Chicago on Dec. 4. The purpose of this meeting will be to adjust the conflicting interests of the towns on the line which want a waterway and the city of Chicago, which wants sewage disposal as well.

THE BALTIMORE & OHIO BRIDGE approaches across the Kill at Elizabethport are progressing slowly, the approach on the Staten Island side not being completed, while work on the Jersey end will not, it is said, be commenced until next spring.

ENGLISH SHIPBUILDING, it appears from Lloyd's return for the quarter ending Sept. 30, has had a very notable revival. The number of vessels in course of construction is 400, against 249 in the corresponding quarter of last year, the gross tonnages being 698,995 and 394,340 respectively. The same tendency has existed for two or three quarters. Of the 400 vessels building, 260, gross tonnage 483,022, are for the United Kingdom; 6, (6,470 tons) for the Colonies; and 13 (36,816 tons) for Germany. The number of steamships built of steel has grown from 143 in the third quarter of 1887, to 279 in that of 1888, while the iron vessels have only risen from 41 to 49. Twenty-seven sailing ships are being built of steel; while in wood and composite ships there is a decline of from 43 to 36.

INLAND NAVIGATION ON THE CONNECTICUT RIVER is strongly urged by Mr. CLEMENS HERSCHEL, among other advocates. The river has been already carefully surveyed, and an estimate was made some years ago, giving the cost of a canal 8 ft. deep in locks and 7 ft. in the river, at about $1,500,000. But Mr. HERSCHEL says that 10 to 12 ft. of depth would now be required.

A POSTAL TUBE FOR THE CHANNEL is now proposed, since a Channel tunnel appears hopeless for the present. The idea is to suspend two tubes of about a yard each in diameter by means of steel cables across the Channel, 120 ft. above the level of the sea. Steel cables will be fixed to pillars at distances of about 800 yds. to carry the tubes, and in each tube a little railway will run with cars capable of carrying 450 lbs. in weight. No parcel of greater weight than this will be taken, and the cost is estimated at the modest (probably over-modest) figure of five million dollars.

THE MOST SERIOUS RAILWAY ACCIDENT of the week was a head collision, Nov. 26, on the Denver & Rio Grande at Husted, Col. Through a recent agreement, the Rock Island uses the track of the Rio Grande from Colorado Springs to Denver. The Salt Lake express on the Rio Grande, from Denver, pulled out of Palmer's Lake eight minutes late, and was thundering down the "divide" at a speed of 30 miles an hour. About a mile south of Husted the track makes a sharp curve, on turning which the engineer saw the Rock Island express close ahead. The engineers and firemen jumped, and a moment afterward the trains came together, telescoping the cars and heaping them up in a pile of broken timber and iron. The upsetting of the stove in the Rio Grande baggage car set fire to the train; and before it could be extinguished three cars were consumed, though fortunately no one was imprisoned in them. The responsibility, it is claimed, rests with the train dispatcher. The conductor of the Rock Island train received orders at Colorado Springs giving him the right of way to Denver, and the conductor of the Rio Grande received his orders at Burnham giving him the right of way to Colorado Springs. Two men were killed and 4 injured, 2 fatally.——Another serious accident was a derailment Nov. 22, caused by a misplaced switch. A special train, with a theatrical company on board, on the Wisconsin Central, was turned upon a sidetrack at a gravel pit near Mellen, Wis., by a switch which had been left open by the brakeman of a gravel train. The locomotive rolled down the embankment and was followed by the baggage car. The passenger cars were derailed but did not turn over, while the two sleepers kept the track; nobody was seriously injured. This is one more "special train" accident.

THE HEAVY STORM during the early part of the week caused considerable damage along the coast. At Coney Island, the concrete work at the Concourse was damaged and most of the shore protection work destroyed. The trestle and one station of the Marine Railway, at Coney Island, were destroyed by the waves. On the Shore Line between New York and Boston, traffic was suspended for a time owing to the damage to bridges. The track of the Boston, Concord & Montreal was flooded near The Weirs, N. H. Washouts have occurred on the Boston, Revere Beach & Lynn. The Maine Central road was undermined by the high water at Lake Maranacook, and a freight train was derailed and went into the lake.

BRIDGE ACCIDENTS are reported as follows: On Nov. 25 travel on the Shore Line was delayed by the breaking of the main shaft of the Connecticut river drawbridge at Lyme, Conn.——On Nov. 25, at the works of the Thames river bridge at New London, Conn., one of the large frames for caisson No. 4 was broken up by the storm.

THE AQUEDUCT COMMISSION has given two more "public hearings" this week on the question of whether to build the Quaker Bridge dam or a number of small dams at the mouth of the Croton river. Mr. JAMES S. SEARLE, an old opponent of the big dam, stated that the building of the dam was impracticable and that even if practicable it would be ineffective as there would not be enough water to supply the reservoir. He promised some facts and figures to prove his statements. JOSEPH BENEDICT, a New York merchant and a resident of Westchester, said the small dams were advocated by the few opponents of the other scheme as being better from both a sanitary and practical standpoint, whereas the fact was that the small reservoirs would be built on cultivated land, and the damage to health from storing water on such soil and the waste from absorption could not be estimated. Dr. JOHN PETERS was in favor of the dam, as the reservoir would be beneficial to health.

THE PANAMA CANAL seems likely to be the cause of much political trouble in France. An ex-agent of the canal company has publicly accused several members of the Government, mentioning two by name, of taking heavy bribes from the company at the time when the question of the authorizing of the lottery of the bonds was under consideration by the Government. The accuser claims to have ample proof of his charge, and has declared his intention to publish all details of the several cases. The canal project seems to be getting deeper and deeper into difficulties.

Address to the Shareholders of the Grand Trunk Railway by President Sir Henry Tyler.

(*Concluded from Page 407*).

RELATIONS WITH THE CANADIAN PACIFIC.

Now I come to the most delicate portion of my duty. I know you will expect me to refer to the Canadian Pacific Railway; and I will begin by reading a letter which I have received from Mr. Miley, one of our proprietors:—

"Dear Sir,—When the Great Western and Grand Trunk companies were promoted, the Government of the time, recognizing that in a thinly-peopled colony, shareholders would be induced to invest more from the future than the immediate prospects of dividends, was careful to point out that, being brought under the ægis of the Government, they would be protected from the opposition of rival companies. How has this promise been kept? I will pass by the building of the Canada Southern which directly opposed both the old lines, for I quite agree with your remark at the last meeting, that it is useless opening up old grievances; but the patience of our shareholders seems only to provoke further attacks on the part of the Canadian Pacific, and we are now threatened with a further opposition by the building of a line from London to Detroit, which will give almost the unique example of four lines serving the same district, running parallel within a few miles of each other! Further, when last year the Board proposed amalgamation with the Hamilton and North Western Railway, they issued a map showing the railway system of the district involved. I must confess that to me, and doubtless to the great majority of my fellow shareholders, this map was, to use an Americanism, an eye opener, and few, I imagine, had any idea that the Government, in the face of their promises, had, in a sparsely peopled district, promoted or permitted an opposition at so many points where there can scarcely be sufficient traffic to pay a single company. Some nine years ago our then president, Mr. Richmond Potter, pointed out how vastly in excess, in proportion to the population, the Canadian railway system was to that of the United Kingdom; since then the mileage has, I believe, been more than doubled, while the population has only fractionally increased, and of all railway systems the Canadian has been, and remains, the most unremunerative and disastrous. The reason is not far to seek, and though on previous occasions you have deprecated allusions on the part of shareholders—and doubtless for valid reasons—to our treatment at the hands of the Dominion Government, I think it is now imperative that a strong protest should be made against what I cannot but think is a grievous injustice and want of faith.

J. MILEY.

You may readily understand that the subject of the Canadian Pacific and its relation to the Grand Trunk formed the subject of a great deal of anxious discussion between myself and Mr. HICKSON and the Grand Trunk officials on my recent visit to Canada. I have never underrated the importance of this question, though I have not feared that the competition of the Canadian Pacific would be such a serious matter as some gentlemen—especially those who are sometimes interested in lowering the price of our securities—pretend to believe. But I have always held the same views, and stated the same views. I have always said that the Canadian Pacific proper, extending from the Atlantic to the Pacific, and connecting various Canadian Provinces one with another, and establishing a Canadian route between the two oceans, was an object of Imperial as well as of Canadian importance, calculated to enlist our sympathies and our warmest wishes, and even to ensure our co-operation; but when that laudable object was mixed up and combined with a series of projects through other portions of the Dominion, unnecessarily, and I may say ostentatiously, competing with the Grand Trunk Company at every point, then we should have been more than mortal and less than human if we had not experienced some sense of injustice, and some prickings of indignation, and more especially so when Parliamentary assistance and Government interference were thrown openly and heavily into the scale against us, and when good faith and friendly relations were not always adhered to in quarters where such influences might have been most expected to prevail.

EXTENSIONS OF THE CANADIAN PACIFIC.

Now, these extensions of the Canadian Pacific Railway are still being pushed forward with the aid of subsidies from the Government. A line has been completed to Guelph, and is to be extended to Goderich. That is one project they have in view. Then, again, what they call the West Ontario Pacific Extension has also been subsidized, and is being constructed parallel to the Grand Trunk and Canada Southern Railway for 110 miles, from London to Detroit; and I am sorry to say that we have not found it possible to make an arrangement with the Canadian Pacific on what we consider reasonable terms, to use our existing lines, of which 70 miles is double, in place of making a new line between those points. Mr. HICKSON was most anxious to make such an arrangement, even though it would give them a means at once of competing on very favorable terms against us.

We received various telegrams and letters from Mr. VAN HORNE on the subject. We replied to them, and tried to negotiate on what we thought a reasonable basis; and we also said, if we give you this opportunity on the very low terms proposed of using our line, and of being practically joint owners of our line between London and Detroit, ought you not to give us similar facilities from Nipissing to Sault Ste. Marie, and make fair arrangements for exchanging traffic at Nipissing for Toronto and Ontario points? We had a right to expect that they would reciprocate, and give us such facilities. But no; that was a very different matter, and we could obtain no favorable reply on that point; indeed they are still sending traffic for Ontario more than 200 miles round by Smith's Falls, rather than allow it to flow over our line from Nipissing direct to Toronto and other points. Much correspondence has passed, but Mr. VAN HORNE has not answered the very courteous letter which Mr. HICKSON wrote to him on September 27 on these subjects.

It would really appear that the Canadian Pacific are determined, if the British public will subscribe the money, to make their own line between London and Detroit; and they are to have a meeting on November 19, with a view to a guarantee of the capital for that line by a lease of it to the Canadian Pacific, and in the correspondence with Mr. VAN HORNE he asserts that he can raise the necessary money at 4 3-10 per cent. In the course of the above correspondence, Mr. VAN HORNE referred to another line the Canadian Pacific Company have obtained powers for, and intend to construct, from Sudbury Junction to Claremont, Ontario, which would be, say 300 miles long, and would cost, say £1,500,000. It remains with you, gentlemen, and others on this market to decide whether they can do so. So long as they can get money from London they will go on building, but is it worth while for us in London to subscribe for competitive projects of this description? That is a question for you to answer.

The Canadian Pacific have—besides constructing and projecting the several railways described above—been long contemplating an extension from Woodstock to Hamilton. They are also completing extensions into Montreal and Toronto at very considerable cost, and are pushing out in numerous other directions, which I need not here refer to. This being so, I feel that the time has come when I cannot, in addressing you, ignore these questions of so much importance to the Grand Trunk Company; and I cannot avoid, therefore, alluding to the subject, and discussing it in public, at the same time keeping, I hope, within the bounds of prudence and good policy in doing so. I earnestly desire that all such questions between the two companies should be discussed without any personal feeling, and simply from a business point of view; but from that point of view we are bound, in order to determine in many respects our own action and our own policy, to consider seriously what are the probabilities in regard to the future of our aggressive competitor.

You know that up to the present time the Canadian Pacific Company have been very successful in obtaining, as they required them, large measures of assistance from the Canadian Government, and they have also obtained, whenever they have asked for it, large sums of money from the British public; and I have always understood investors to say, "We do not know much about the Canadian Pacific, but they are sure to get further assistance from the Canadian Government, which is bound to carry them through." There has been a feeling, in fact, that whatever their difficulties might be, the Canadian Government was bound to assist them, as the Government agents have by issuing their loans.

THE FUTURE PROSPECTS OF THE CANADIAN PACIFIC.

Having regard, then, to these extensions which the Canadian Pacific are now making, in competition with the Grand Trunk Company, and to the future course, and the future action, and the future commitments of the Grand Trunk Company, it is of the first importance for us, I think, to seek a reply to a few very pertinent, though perhaps not very agreeable questions, which we would otherwise not care to discuss in public. Now, the first question which we have to consider is—Is it possible that the Canadian Pacific Railway will be able to obtain any further large measure of assistance from the Canadian Government? We cannot conceive that the Canadian Government would themselves answer that question in the affirmative. Then, in the absence of this probability, how far will they be able to raise all the money which they may require for these numerous extensions and projects in the British money market—from the British public—from you, in fact, gentlemen? I will leave you to answer that question.

Then the third question I have to answer is this: As time goes on the renewals are required, and as the accounts of the Canadian Pacific Company come down to an ordinary basis, will their net profits suffice to pay their fixed charges, amounting as they now do—since they obtained their last $15,000,000 guarantee from the Canadian Government—to $4,085,084 a year—upwards of two million dollars every half year? If their resources and net profits are sufficient, we shall have a very formidable rival to contend with; but we shall not be found, depend upon it, unequal to the task. If their net profits are not sufficient in any half year to meet all these fixed charges, then, gentlemen, what will happen next? because some very important questions must then arise, as to whether the Canadian Government will not, in any case, have to take over and keep open that portion of the line which connects Montreal and the Pacific; and what is then to become of the other parts of the extensive system which they have been constructing, and are constructing, mostly in competition with the Grand Trunk Railway throughout Canada, and even beyond its borders. These, gentlemen, may be inconvenient questions, but they are vital in importance to us, having charge of the enormous interests of the Grand Trunk Company. I think we should be absolutely neglecting our duty if we did not seriously consider them, and if we did not also at this juncture direct your attention to them. Sir GEORGE STEPHEN has, as you are aware, retired from the presidency of the Canadian Pacific Company, and has stated his reasons for doing so; and we are bound to consider whether any crisis is likely to occur in the affairs of that company, and, as far as we can ascertain the facts, further to compute the time when, if such a crisis seems at all probable, it is likely to be expected. Meanwhile you will have observed that the Northern Pacific has taken over, and has commenced to work, the Red River line of the Manitoba Government, and that, therefore some of the grain and produce of Manitoba may find its way to Duluth, and so by propellers to our lake ports, if it does not do so by rail in the meantime. In fact, the Canadian Pacific Company, now that they have spread their network of lines over so extensive a territory, will, necessarily, be exposed to the disadvantages of competition, which they have so eagerly applied to us; and they may not, perhaps, accept so patiently and with so little complaint, and will feel even more keenly and substantially, evils such as they have nowhere hesitated to inflict.

TRUNK LINE COMPETITION.

You will remember, I explained to you in June the conditions up to that time of the dressed beef traffic. That dressed beef-traffic was suddenly abstracted from us in October, 1887. But when we met at the special meeting in June, I had the pleasure of reporting to you that the dressed beef traffic, of which we formerly carried the bulk, had partially returned to our main line, and we were thus obtaining it by means of differential rates accorded to the Chicago & Grand Trunk for New England. However, the Pennsylvania Company after that became restless, and claimed that they were suffering loss, and reduced the dressed beef rate from 65 cts. to 46½ cts. to New York and Boston, and the cattle rate from 25 cts. to 16½ cts., and the hog rates from 30 cts. to 25 cts. The Chicago & Atlantic (Erie), insisting also on differential rates, reduced the dressed beef to 40 cts. This was followed by the Vanderbilt lines. The warfare was continued, and at last our officers would not reduce any further, and kept up the rates while the others were going far below the rates we were obtaining. Then, unfortunately, this rate cutting was extended to other items. On July 15, Mr. REEVE reports that cattle by the Pennsylvania lines were carried at 5½ cts., and by the Vanderbilt lines 5½ to New York and 40½ cts. to Boston, and that the dressed beef, which ought to have commanded 65 cts., was carried at 7 cts., and so on. Now, here is a little extract from the Chicago *Tribune*, which will show you how we were keeping up the rates when other companies were taking absolutely absurd rates:

"The Grand Trunk continues to carry the bulk of the Boston and New England dressed beef, although it has not reduced the rate below 26½ cts."

Now that gives you an idea of what we have had to contend with. Even while they were cutting rates to 6 cts. and 7 cts. against one another, we were carrying at 30 cts. You cannot get much profit even out of that. The condition of affairs was deplorable. On September 28 the Pennsylvania Company agreed to a partial restoration of provision rates up to 25 cts. for 100 lbs., and a full restoration of high-class rates; but they declined to assent to a restoration of dressed beef, cattle, butter, eggs, or grain and flour rates. The new rates were to come into force on the 10th, and were afterwards postponed to October 15th. I assure you, gentlemen, that our officers have been doing all they possibly could, working with other companies, to try and restore rates. While I was out there I co-operated with them, and I can tell you they did all they could. But even recently the Pennsylvania Company reduced their rates from 25 cts. to 20 cts. for grain at a time the traffic was coming on, and we all had more than we could possibly carry—that is to say, we could have employed a great many more cars than were available. One day Mr. SEARGEANT told me that if we had 2,000 more cars we could have employed them all, and that was the time they thought fit to reduce the rates.

When I was at Chicago we went seriously into the question, whether we should not put up these grain rates ourselves, and leave other companies to do what they liked. The answer to that was that it would put us in an invidious position with regard to the traders. Then we tried to get other companies to join us in increasing the rates, even if the Pennsylvania Company would not do so. The Michigan Central and the Pennsylvania were, however, mainly the means of keeping the rates down. Even at the present moment, although there is, I hope, a better prospect, and although the class rates have been all restored, the grain rate question and the dressed beef question have not yet been settled, but I hope they will be before long.

It is abundantly evident, gentlemen, that there is not enough proper feeling amongst us in America to keep the rates up without some further legislation, and if there should be any further legislation on the part of the American Government, and if the Inter-State Commerce Commission should obtain some further power, I do not think it would be to our disadvantage, or to that of the American companies, because, as I have said before in

this room, no legislation, no interference by any Government or any Commission between the different companies, could do anything like the harm that we do to each other. But although one requires a great deal more than the patience of Job in this matter of rates, I do hope we are going to end this business, and that we shall have rates restored in a satisfactory manner. In any case you may be assured that the best efforts of all the officers of the Grand Trunk Company will be constantly directed to the improvement of these rates and to a fair distribution of traffic, with a view to avoid in future undue competition.

DISCUSSION.

Mr. BOYDELL.—There is one subject I should like to mention. I have no policy to suggest. I simply think that honesty is the best policy, and I further think it is sometimes necessary to "tell the truth and shame the devil", and I would not hesitate to assert my opinion with respect to the action of the Canadian Government in regard to this company, that a more dishonest action was never perpetrated by any Government in any of the four quarters of the globe. If there was need for these extensions of the Canadian Pacific Railway, why was not it made an extension of the Grand Trunk originally? Why should not the Grand Trunk system have been extended and continued across the continent without the incorporation of a rival company? I say that in the representations that were held out to the investing public in the original prospectus, the Canadian Government robbed the speculators of this company, and they are robbing the investing public by putting forward rival schemes, which in turn will be failures owing to the same dishonest policy. We have never taken up a firm position. For many years we were under the thraldom of Messrs. Baring Brothers, whom I can only describe as the dishonest agents of a dishonest Government; they have not hesitated to bring out a loan of several millions to bring about the extension of the Canadian Pacific Company in furtherance of competition with this company; and I say that if the investing public truly appreciated the action of Messrs. Baring Brothers, they would be loth to invest any further in Canadian securities until the Canadian Government had done justice by this company. We have a right to ask the Canadian Goverment for an explanation of their conduct. They are, to a certain extent, partners in this company. I think that the attention of the whole body interested in Grand Trunk securities should be drawn to these things, and that the best way of doing so is to reprint the original prospectus, and let it be scattered broadcast throughout the land, in order that the investing public may themselves judge of the dishonest action of that dishonest Government, the Canadian Government.

Mr. THOMAS ADAMS.—I hope our worthy chairman will not lay any more money out in Canada until he gives us a return on the third preference stock, which has been in difficulties for so many years. It is not for want of traffic, but for want of prices, and while they are such fools there as not to earn as much as they can but to lose as much as they can for the shareholders, and take the traffic at unremunerative rates, things will not be better. It is perfectly well known that it is much more expensive to carry traffic in Canada than it is here, yet the rates are perfectly ruinous, as you have heard to-day. I am anxious that the shareholders should get something for their money, and while they do not get it it must be the fault of the companies on the whole, because it is ridiculous to see the rates they take. I only wish we were more prosperous than we are—(Hear, hear)

Mr. HATCH.—Gentlemen, I beg to propose that the best thanks of this meeting be offered to our President for his able and courteous conduct in the chair. Personally, I am sorry that so large a proportion of his speech was historical, and so small a portion prophetic, but I remember now that on previous occasions Sir HENRY TYLER has told us he never liked to prophesy without he knew, and, with the question of rates still unsettled, I am afraid we are still groping through misery's darkest caverns.

"How rapidly we are becoming Americanized", remarks the English "Machinery Market", "is strikingly seen in the adoption here of the great system of 'trusts' or 'monopolies', which flourish on the other side of the water. The 'Salt Union' is reported to be successfully launched, and with its shares at a premium, it is not surprising to hear next of a proposed combination on some similar basis of the ironmaking firms." We fully expect to find that this will prove to be the case; and we make bold to add that one reason for the multiplication of such combinations is that they have a certain rational and defensible excuse for existence, and when properly regulated by law (as they badly need to be) will prove to be anything but unmixed evils. They are simply another form of the universal modern tendency, to bring larger and larger aggregates of capital under a single management, which finds expression in our railway consolidations; and they have something like the same excuse, properly controlled,

Sodom Dam; New York Water Supply.

The Sodom dam, now being built by the Aqueduct Commission of New York to impound the water of the East Branch of Croton river, will add some 8,000,000,000 galls. to the supply available during dry seasons. The water will flow to Croton dam and enter the aqueduct through the gate house, which we illustrated and described in a recent issue. The reservoir at Sodom will be formed by two dams, a masonry one 88 ft. high, 12 ft. wide at the top, 47 ft. thick at the bottom and 500 ft. long. The foundation for this dam will be carried down until seamless rock is encountered, recesses being cut in the rock of the hills to receive the ends. During the construction of this dam the course of the stream is deflected by a crib dam. At the eastern end is a low hill separating the masonry from an earth dam having a rubble core. This hill will be graded to the elevation of tops of both dams, 425 ft. above datum. The earth dam extends north about at right angles with the other, as shown on the accompanying map. North of the earth dam is the overfall. Drawings of the section of both of these dams are presented.

The flow from the reservoir will be through two 48-in. pipes and five 12-in. pipes leading to an aerating fountain located just below the masonry dam. (See Fig., 4.) The supply will be controlled by suitable valves in the gate-house shown.

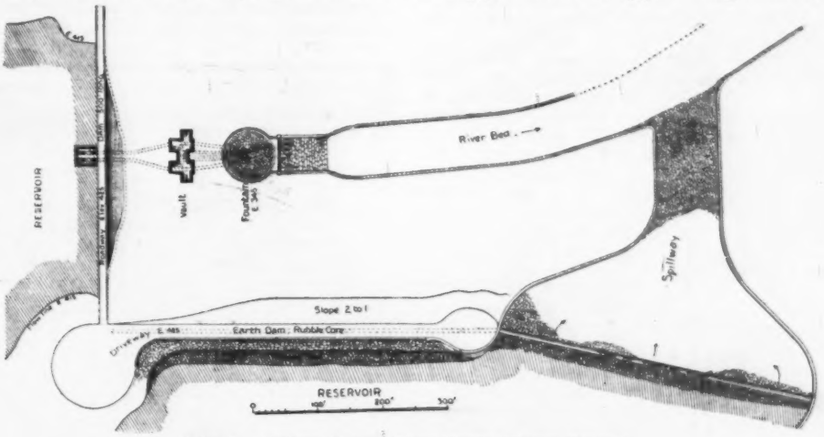


Fig. 1.—Sodom Dam; New York Water Supply.
General Plan, showing Masonry and Earthen Dam with Fountain and Spillway.

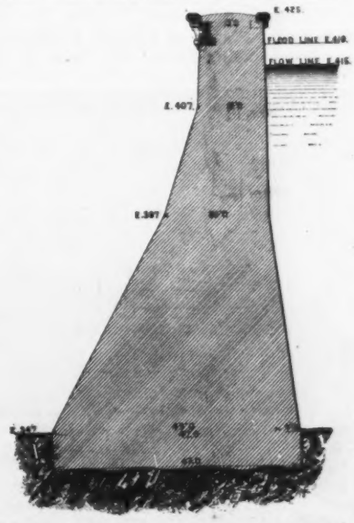


Fig. 2.—Sodom Dam; Masonry Cross-Section.

The arrangement of the plant for building the masonry dam is clearly shown in the annexed plan and elevation (Fig. 5,) for which we are indebted to the courtesy of Assistant Engineer WALTER MCCULLOH. It is doubtful if a site possessing more physical adaptations to the cable system of handling material could be selected than that of this dam. The hill at each side rises to a height sufficient for the cable to clear the top of the dam after the latter has been finished. On each hill is a frame tower (Fig. 6,) in line with the center of the dam. These are placed 762 ft. apart. Stretched across the valley from tower to tower is a 2-in. solid center steel cable upon which runs a double trolley sheave secured in a rectangular iron frame, which is operated by an endless rope passing around one drum of the hoisting engine placed at the western end. The cable is held at each end by a log deadman sunk in a trench at right angles to the line.

The trench is excavated in solid rock, and the deadman is heavily loaded with live rock. To place the cable in position one end was made fast at the eastern tower, then to the opposite end was secured a chain which was passed over the second tower to the drum of the hoisting engine. By this means the cable was raised as far as the chain would allow and there held until a new hold could be obtained. The final tightening was done by turnbuckles after the end had been passed around the deadman and secured.

Running upon the cable is the carriage above mentioned. This is provided, in addition to the two trolley sheaves running upon the cable, with two others at the lower corners of the frame for handling the fall rope. The frame forms part of the circuit of a ⅝-in. endless steel rope which passes around an idle sheave at the eastern tower and four times around a concave friction winch drum of the hoisting engine. The endless ropes serves to move the carriage to any desired point on the cable. The hoisting rope is wound upon a grooved drum of the same diameter as the winch, 54 ins. The rope passes over one of the lower pair of pulleys of the carriage, then around the pulley block, then over the other

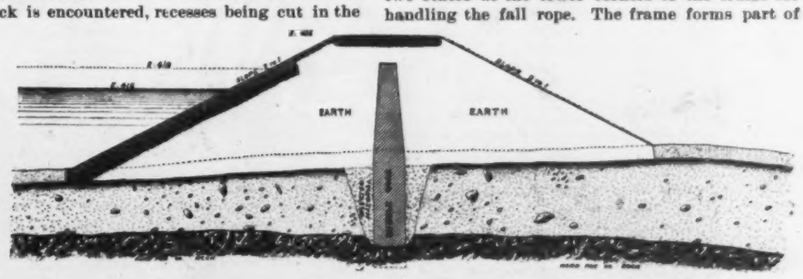


Fig. 3.—Sodom Dam; Cross-Section of Earthen Embankment.

pulley and its end is made fast to the block. The hoisting rope is prevented from sagging by meals of wooden blocks—fall rope carriers—riding on the cable and held from separating more than 25 ft.

upon the same shaft to which motion is transmitted from the engine shaft by gearing. Either drum can be thrown into gear by means of a lever operating a friction clutch. A second lever, one for each

The location of the derricks and their hoisting engines are shown in the plan. These act as aids to the cable, collecting the load to be carried away and distributing the material brought when its destina-

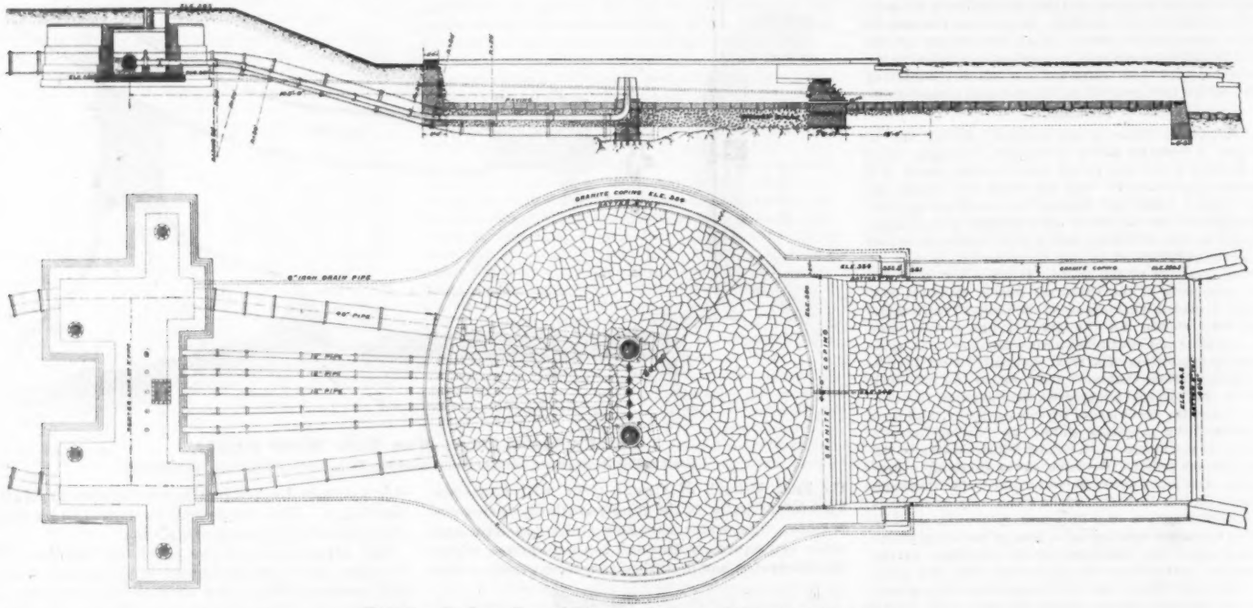


Fig. 4.—Sodom Dam; Plan and Central Sectionof Outlet.

Showing Flow of Water from this Reservoir towards Croton Dam. With Mains, Valve-chamber, Aerating Fountain, Etc.

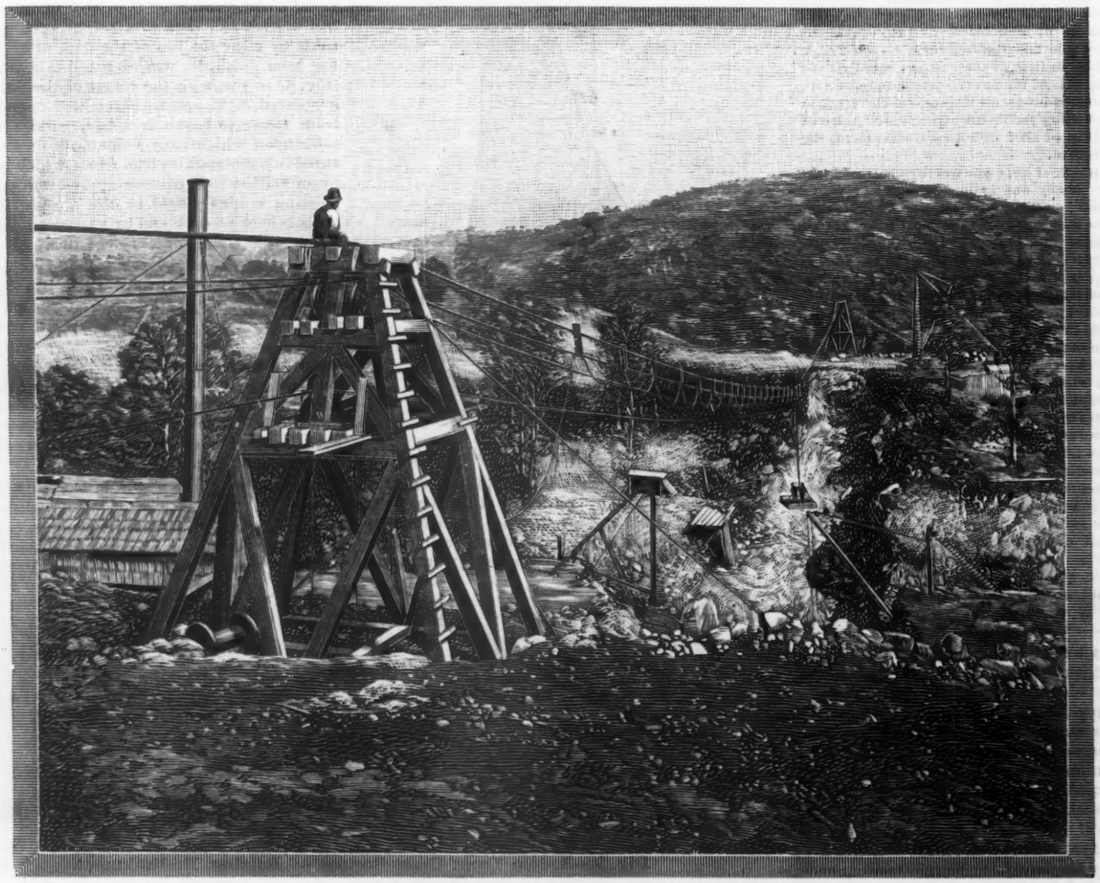


Fig. 6.—Sodom Dam; Cable Plant for Construction.

Towers, Cables, Carrier and Engines Furnished and Erected by the LIDGERWOO MANUFACTURING Co.

from each other by chains when the carriage is at the most distant point of its travel. The rope passes through openings near the lower ends of the blocks.

The engine is a double friction drum and link motion of 50 H. P., and is operated by five levers in addition to the throttle; the drums are mounted loosely

drum, operates a brake band. The fifth lever controls a link motion for reversing. This makes the drums entirely independent of each other, and permits the hoisting or lowering of the load while it is being carried in either direction along the cable. The capacity of the cable is 20 tons.

tion is outside the line of the cable. Stone is brought from the New York & New England Rail road over a track located about half-way up the western hill.

The cable and engine were furnished and erected by the Lidgerwood Manufacturing Co. The dams

are being built by Sullivan, Rider & Dougherty, the contract price being $450,000.

Heretofore this system of handling material, the invention of MILO W. LOCKE, has been used principally in quarrying. The above description shows

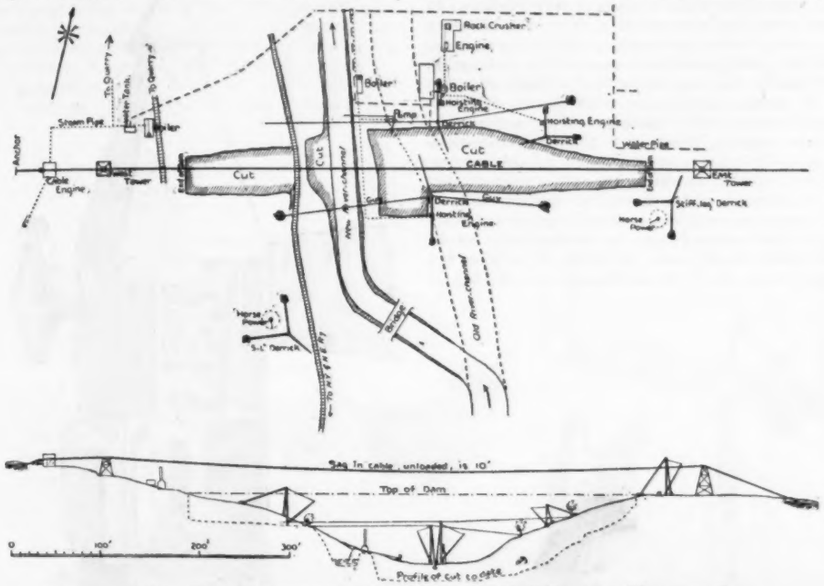


Fig. 5.—Sodom Dam. Arrangement of Plant for Building the Masonry Dam.
Drawn to Scale by WALTER MCCULLOH, Assistant Engineer in Charge.

its admirable adaptability to the handling of supplies and refuse in an engineering work.

A MINING PUMP of 25,000,000 galls. capacity daily is being built in Providence, R. I., for the Calumet & Hecla Mining Co. The plungers are 34×48 in. So says an exchange.

Cellulose Armor.*

When the peculiar properties of "amorphous cellulose" were first ascertained, Rear Admiral PALLU DE BARRIERE, of the French navy, enthusiastically advocated its use to prevent water entering a leak in a vessel's side, and to furnish vessels whose trim could not be altered even when riddled with shot holes.

*From *Mittheilungen aus dem Gebiete des Seewesens*. Austrian Hydrographic Office, Sept. 1, 1888. It appears here for the first time in English, in America at least.

This cellulose is a substance produced by a patent secret process from cocoanut husk. The process is patented in all countries, but the firm of TORRILHON & Co., at Chamalières near Clermont-Ferraud, France owns the patent. The patent does not prevent the production of cellulose by other methods, but excepting a firm in Italy, this is the only place where it is manufactured. The secret is merely that of a mechanical process.

Amorphous cellulose consists of two materials, the meal and fibre. The fibre has the natural color of cocoanut husk and the strength of horse hair, varying in length from 3 to 12 ins. The meal, the chief ingredient in the coffer-dam cellulose, is also of the same color as cocoanuts and consists of fine grains mixed with bits of fibre. The loose cellulose weighs 65 kilogs. per cu. m. or 110 lbs. per cu. yd.: when compressed, a cu. yd. weighs 210 lbs. Its specific gravity is far less than that of cork. It is the lightest solid known and therefore invaluable for life belts and life mattresses, while in large quantities its buoyancy will make a ship nonsinkable.

Compressed cellulose is used to fill compartments in a ship's side and serves to prevent water entering the ship through a hole made by a projectile. It does not decay or emit any odor and has been packed in ships' compartments for several years without undergoing any change. If a mass of cellulose be penetrated by a projectile it will not be ignited by the friction as happens with india rubber, which is invariably ignited and gives off a dense disagreeable and unquenchable smoke, preventing all access to the shot hole.

When dry, loose cellulose is ignited, it will burn with a flame and give off a white transparent, odorless smoke, and leave a residum resembling lampblack. It is difficult to ignite compressed cellulose; and damp compressed cellulose will not burn at all. It swells rapidly when wet and soon stops the flow of water. If the neck of a bottle full of water be filled with cellulose, it will effectually cork the bottle.

The cellulose used for armor is made in the proportion of 1 part by weight of the fiber to 15 parts by

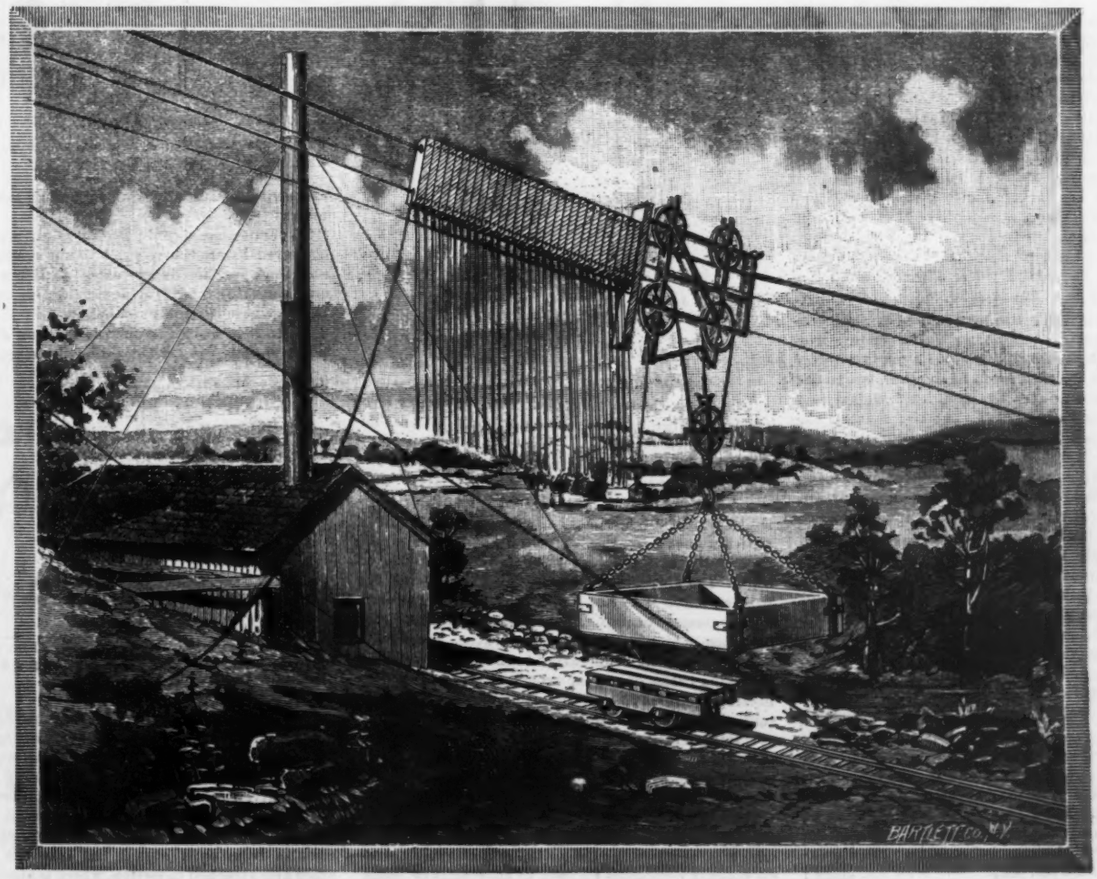


Fig. 7.—Sodom Dam; Cable Plant, Fall-Rope Carriers and Chains.

weight of the meal. In packing the compartments, the fiber is laid on a table about 6 ft. square and spread out evenly with a thickness of about one-tenth of an inch, the meal is then spread over the fiber evenly about 2 ins. thick. Rectangular blocks are laid off by hand 8×10 ins., and placed in the compartments on the bottom. Four or five layers of these blocks are laid and then compressed by means of weights on boards. Sometimes a man enters and compresses the cellulose by stamping on the boards. After the first layers are compressed, the boards and weights are removed and additional layers laid in the same manner until the compartment is entirely filled, the cellulose being compressed as each series of four or five layers are laid.

It is not necessary to ventilate the compartments nor to inspect it periodically. At the factory the cellulose is simply packed in bags containing 100 lbs. of loose or 150 lbs. of compressed cellulose. It is however advisable to shake it out before using. The price of cellulose at the factory is 1.75 francs per kilog., or 17 cts. per lb. The weight of the bag and expense of carriage are also charged.

Cellulose was introduced in French war ships through Admiral PALLU DE BARRIERE. But Russia and Japan have adopted it in several of their vessels. The French navy has bought the following quantities: in 1883, 10,000 kilogs.; in 1884, 196,000 kilogs.; in 1885, 40,000 kilogs.; in 1886, 165,000 kilogs., and in 1887, 74,000 kilogs., or a total of 1,067,000 lbs. or about 500 tons in the last five years.

Of that which was bought in 1886, the following quantities were placed in the following ships of the French navy.

In the *Admiral Cecille*	40,000 kilogs.
" *Tage*	75,000 "
" *Surcouf*	26,000 "

By the returns since its establishment in 1883 the factory has sold the following quantities: to the French government 700,000 kilogs.; to Russia 80,000 kilogs., to Japan, 225,000 kilogs. Italy, Greece, Denmark and Spain will adopt cellulose in their ships now building.

In the French navy, cellulose is tested by its color, its specific gravity, and its capacity for absorbing water. The latter test is made by filling a small cask with compressed cellulose and suspending it in water from one arm of a scale balance. The head of the cask has a hole covered with a wire sieve. The cask is kept submerged at a depth of 10 ft. for a definite length of time, the increase in the weight shows the quantity of water absorbed. The French require that the amount of water absorbed shall not exceed 6 kilogs. in 10 hours or 10 kilogs. in 18 hours.

At Toulon a box of cellulose was fired at and penetrated by a 10.5 in. projectile under water. Immediately after penetration, about 15 quarts of water flowed through the path made by the shot, but in the course of a few minutes the cellulose swelled and closed the canal completely. At the factory the cellulose is tested by imitating the penetration of shot. A cask being fitted with a water chamber has an iron rod passed through its center containing compressed cellulose, and a model of a shot is drawn through to form a canal into which water flows under pressure until the cellulose stops up the canal. This test simply imitates the effect of a projectile through a compartment at or below the water line of a ship. The leakage of water through such a shot hole is effectually stopped by the action of the cellulose. Cellulose is inexpensive, easily made and is considered a valuable material for unarmored portions of a ship. Its elasticity, low specific gravity and its wonderful capacity for absorbing moisture will suggest desirable qualities for other industrial purposes.

THE GREAT GAS PIPE LINE at Pittsburg, Pa., has been completed. The line is formed of 22,700 ft. of cast-iron pipe and 400 ft. of wrought-iron pipe; the inside diameter of the pipe being 36 ins. The cast-iron pipe weighs 485 lbs. per ft.; and is 1¼ ins. thick; the wrought-iron pipe is ⅜-in. thick, and weighs 190 lbs. per ft. The former has lead and asphaltum joints, with double escapes; the latter has an asbestos flange joint. All calking is done from the inside of the pipe, so that the pressure of the gas will only serve to make the joint tighter. The pipe, when tested at the works, stood 300 lbs. pressure and 80 lbs. pressure when laid.

Long's Electric Semaphore Signal.

This new application of electricity is especially adapted for distance signaling, as it can be operated with precision and certainty at any distance required in the operation of a railroad, and in any situation that can be reached by wire circuits. In its present form the operation at 10 miles distance is entirely within its capacity, and by simple modifications, much greater distances will be practicable.

Its action does not depend upon a single actuation of an electro magnet like most electrical devices, but it acts by many repetitions of the action of an electro magnet, which is vitalized by alternating currents from the most simple and reliable generator of electricity known in the arts, a magneto electric generator, which having no commutator, requires no cleaning, etc., and will operate for years without attention so long as mechanically whole. The infinitesimal part of the labor of moving the signal which has to be performed by a single pul-

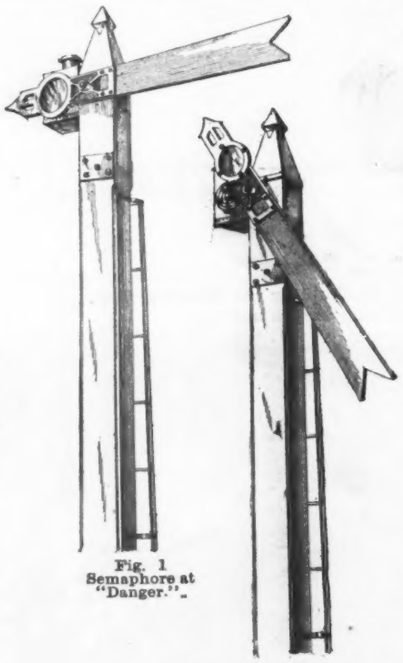


Fig. 1
Semaphore at "Danger."

Fig. 2
Semaphore at "Safety."

sation of the electro magnet used, gives an extremely large margin and prevents uncertainty under adverse conditions.

The semaphore arm is arranged to assume the two conventional positions indicating respectively "danger" and "safety". The first by extending horizontally, as shown in Fig 1, the other by the inclined position shown in Fig. 2, which shows the signal as usually mounted on a wooden post about 20 ft. high. The semaphore arm is 63 ins. long, and the wooden blade is 48 ins. long. The shaft of the semaphore passes through the sides of the weather proof iron case which encloses the apparatus. See Figs. 3 and 4. Movement is imparted to the semaphore by a revolving crank on a gear wheel shaft, a link connecting the revolving crank with a crank arm on the semaphore shaft in such a manner that when the revolving crank is on the upper center, the semaphore is held firmly in the "danger" position, and in the "safety" position when the revolving crank is on the lower center.

The half revolution of the gear wheel necessary to change the signal is effected through a small pinion which is revolved by the action of a vibrating electro magnet connected by rods to the shells or cases of two silent clutches (or ball ratchets) on the shaft of the pinion. The hubs of the clutches have inclined recesses for balls or rollers, which rolling inward release, and rolling outward engage (see broken out part in Fig. 4) and when the rods rise no movement of the hubs (and pinion) is produced, but when the rods descend the hubs rotate. The rapidly alternating movements of the electro magnet thus produce steady rotation of the pinion, gear wheel, and revolving crank, until the latter reaches the center towards which it is moved, whereupon, by an automatic rotating switch, the electric currents

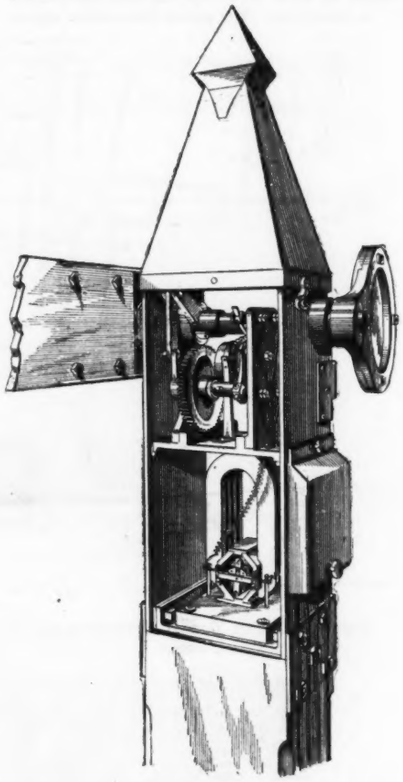


FIG. 3.
Front View of Motor Apparatus; with Enclosing Slides Removed.

are switched off and the apparatus remains dormant.

To change the signal the electric currents are now conveyed by another circuit to the electro magnet, and the operation is the same until the revolving crank making a half revolution arrives on the other center where it remains as before.

When it is desired to operate from an office one or more signals, at considerable distance; say at a

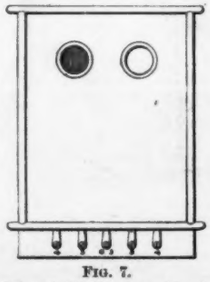


FIG. 7.
Visual Indicator for 2 Signals. Indicating by Color.

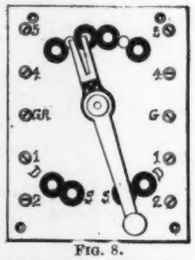


FIG. 8.
Switch for 2 Signals.

junction where trains may be arriving by different routes, and perhaps other trains awaiting starting orders on distant sidings; or at a station where it may be desirable to stop rapidly moving trains, by notice given at a distance; the semaphore signals will be erected at the places where trains should be governed by them, irrespective of distance, and wire circuits from each signal led into the operating office and attached to switch, which is also connected with visual indicators, and magneto electric generator, arranged for hand operation. The generator can be attached to the underside of a table top or otherwise placed as may be convenient.

When either signal is to be changed the handle of the switch will be turned to the points belonging to the signal and the handle of the generator turned a few times until the indicator of the desired signal

shows the desired position of the signal. Each indicator is actuated only by the currents that have been cut off from the vibrating electro magnet of the signal, by the automatic rotating switch, returned by another wire to the office, and it is therefore impossible to be misled as to the position of the signal. The action of the indicator also automatically cuts out the generator from that circuit and the completion of the operation will be detected instantly by the person handling the generator.

The hand generator is covered with a neat case, not shown in Fig. 5. The indicators, two patterns

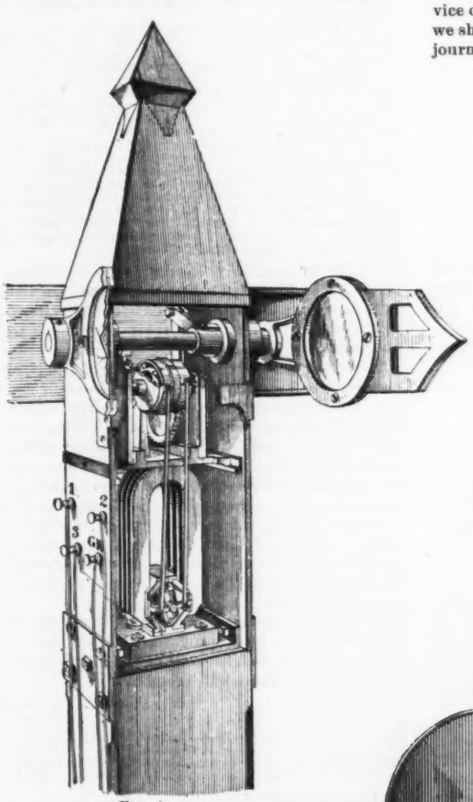


FIG. 4.
Rear View of Motor Apparatus, with Enclosing Slides Removed, and Parts Obstructing View Broken out.

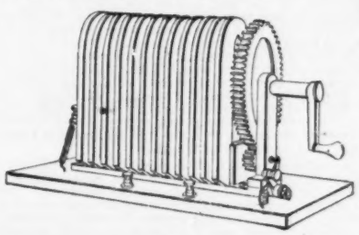


FIG. 5.
Hand Magneto Generator.

of which are shown in Fig. 6 & 7, may be fixed on the walls to be easily seen. Switches are made for any desired number of signals, one for 2 signals is shown in Fig. 8, and they can be fixed on a table or wall as most convenient.

It is obvious that signals can be operated by the most delicate or feeble persons employed, and from offices so located that working a signal mechanically from them would be impossible.

For operation outside an office, as, for instance, for a water station, where the trainmen would be required to operate a distant signal, the generator is furnished in a strong iron case suitable for fastening on a post or telegraph pole. When the case is unlocked, the folding handle may be drawn out. The switch, in the same case, is provided with a bell to indicate when the semaphore has taken the desired position.

It has been suggested that in case a train were improperly dispatched from a station equipped with distant signals of this kind and the fact were discovered before the train passed beyond the semaphore, a "recall signal" could be given the train by raising and lowering the signal as rapidly as possible. Instances are numerous in which collisions, brought about by a momentary lapse of an operator or dispatcher, could have been prevented by such a "recall signal", say half or three quarters of a mile from the station.

This semaphore signal is also employed in an *Automatic Block Signal* system that has already met with considerable favor and is going into service on a number of important railroads, of which we shall publish a description in a later issue of our journal.

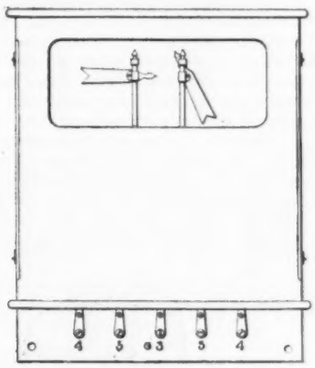


FIG. 6.
Visual Indicator for 2 Signals (Indicating by Position.)

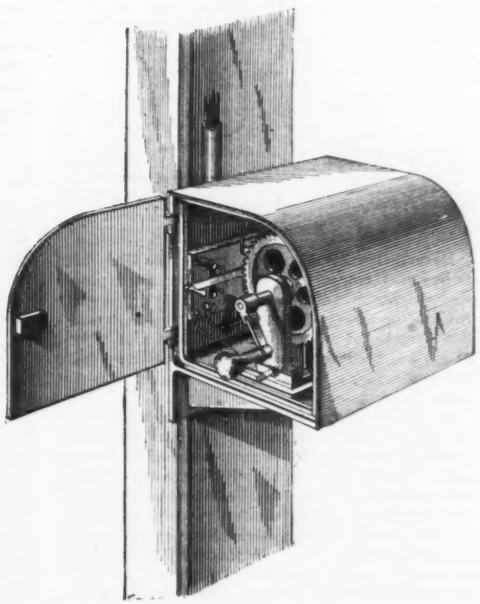


FIG. 9.
Magneto Generator for Outside Use.

This electric semaphore signal is manufactured under Mr. LONG'S patent by the Pennsylvania Steel Co., of Steelton, Pa.

THE TENTH CENSUS REPORT of the U. S. is now completed by the late issue of volume 22. The original appropriation of March 3 1879, was $3,000,000. FRANCIS A. WALKER was Superintendent until Nov. 3, 1881, then came C. W. SEATON until March 3, 1885, when the bureau was abolished and the work was brought to a close by Mr. WARDLE. The report complete includes 22 volumes of data, a preliminary volume of population and a compendium of 2 qnarto volumes of 1772 pages. The whole report covers 19,304 pages; and its cost, exclusive of printing, engraving and binding, $4,853,350, or 9.68 cents per capita of population in 1880. The appropriation for printing, engraving and binding was $1,018,116.

"Varieties of Clay, and Their Distinguishing Qualities for Making Good Puddle."

BY WILLIAM GALLON, ASSOC. M. INST. C. E.*

Geologists agree in ascribing the origin of clays to the decomposition and disintegration of the feldspars in granite, gneiss, mica slate, and clay slate, by atmospheric erosion and trituration in water. The argillaceous rocks, from which clays are principally derived, are distinguished by a peculiar earthy odor, emitted by them when breathed upon. Clay-beds are due to the deposition of water-borne materials at the bottom of estuaries, lakes, or seas; and boulder-clay is ascribed to glacial action. Any substance formed of minute particles of decomposed earthy material, which, when worked up with water, becomes plastic or capable of being moulded, is commonly called clay. No natural deposit of absolutely pure clay has been found; but the residue, after washing out all the impurities from clay, is a hydrated silicate of alumina, which is the plastic, and consequently the most important, constituent of clay, insoluble in water, and incapable of supporting vegetable life. Water combined with the silicate of alumina gives it its plasticity. Part of this water is merely absorbed into the pores of the clay, and can be driven off by exposing the material to a temperature of about 212° Fahr.; but the remainder, which is in combination with the clay, can only be removed by a prolonged high temperature, as in baking bricks, depriving the material of its plasticity, and causing it to shrink in proportion to the bulk of water expelled. Some analyses of different kinds of clay gave from 46 to 66 per cent. of silica, 22 to 38 per cent. of alumina, from 5 to 13 per cent. of water, small variable quantities of oxide of iron and lime, and traces of magnesia.

The purest form of clay, containing the largest proportion of alumina, is known as kaolin, the name of a mountain in China, where a pure white clay is worked, described as a pure chalk-white, dull, earthy, unctuous substance. The kaolin found in Devonshire and Cornwall, is called Cornish, or sometimes China clay. Teignmouth clay, so-called from being shipped at Teignmouth, is as free from quartz as washed kaolin, and is believed to be the sediment washed down from Dartmoor, which was deposited in a fresh-water lake. Some clays are designated by the principal use to which they are applied, namely, china clay, potter's-clay, pipe clay, and fire-clay. The main difference between china-clay and pipe-clay consists in the proportion of silica in their composition. Pipe-clay shrinks too much in heating to be available for making pottery. Potter's-clay includes a variety of clays containing considerable quantities of impurities. Fire-clay resists fusion owing to the large proportion of silica it contains; thus Stourbridge fire-clay contains 65 per cent. of silica, or nearly 20 per cent. more than pure kaolin. Clays are also designated by their color, as red, blue, brown, yellow or ochre, and variegated clay. The coloring matters consists mainly of metallic oxides, notably oxide of iron; organic substances also affect the color. A red color in clay in its natural state indicates the presence of peroxide of iron. A yellowish or brown color denotes the presence of hydrated peroxide of iron in the clay, which becoming anhydrous on burning imparts a red color to the clay. The Dorset and Devonshire clays, being free from iron, are white when burnt, which renders them especially valuable for pottery. Clays containing manifest impurities to a considerable extent are designated by the terms shaly clay, sandy clay, loamy clay, and marly clay. Any soft admixture of clay and lime is termed a marl—clay-marl when the clay is in excess, and marl-clay when the lime predominates. Many clays are known by the name of the neighborhood from which they are obtained such as London clay, Oxford clay, Grinstead clay, Wadhurst clay, Weald clay, Kimmeridge clay, Gault clay, Pole clay and others.

Puddle is of considerable importance in engineering works for arresting the passage of water. Some clays, such as the London, Kimmeridge, and Oxford beds, are practically impervious to water in their natural condition; whilst others offer more or less resistance to its passage in proportion to the absence

*Abstract from Proceedings of the Institution of Civil Engineers.

of impurities. Springs at faults or at the outcrop of clay-beds furnish evidence of the impermeability of these beds. Most clays, when free from coarse gritty impurities, contain sufficient alumina to become practically impervious to water when worked up into puddle. When puddle is protected from evaporation, as is generally the case, the admixture of impurities has the disadvantage of diminishing its cohesiveness, and consequently its impermeability. If, however, puddle is placed so near the surface as to be liable to lose its moisture by evaporation, or capillary attraction during dry weather, the addition of sand may be necessary to prevent the contraction of the mass, and the consequent formation of fissures such as occur in clay soils in times of drought. The sand, by diminishing the cohesiveness of the clay, obviates the rupture produced by the contraction of a tenacious mass; and with this object, the brickmaker adds sand to clays deficient in silica to prevent his bricks cracking when being burnt, and the potter incorporates ground flint with his clay to reduce the amount of contraction.

The general suitability of most kinds of clay for puddle has caused an absence of precision in the definition of the requirements for puddle in specifications. The essential condition for puddle is that it must be impervious to water; and no special purity in the clay is required to attain this result. Tempering the clay by working it up with water, so that its original formation is broken up and a new arrangement of particles formed, with additional water to fill up every pore, is the important requisite for the formation of good puddle. It is peculiar that puddle, though formed to exclude water, should require water, for its manufacture. Tempering clay for forming puddle is greatly facilitated by exposing the material to the atmosphere, especially in winter, when rain, snow, frost, and changes of temperature disintegrate the clay more thoroughly than even grinding it in a pug mill; and the labor of working it into puddle by cutting, cross-cutting, poaching it with a tool, or treading, is materially reduced. Clays well suited for puddle are opaque and not crystallized; they exhibit a dull, earthy fracture, exhale, when breathed upon, a peculiar faint smell termed argillaceous, are unctuous to the touch free from all gritty matter, and form a plastic paste with water.

The important properties of clay for making good puddle are its tenacity or cohesion, and its power of retaining water, which really coexist, but are separated to facilitate description. The tenacity of a clay may be tested by working up a small quantity with water into a thoroughly plastic condition, and forming it by hand into a roll about 1 to 1½-ins. in diameter by 10 to 12-ins. in length. If such a roll is sufficiently cohesive not to break on being suspended by one end when wet, the tenacity of the material is ample. To test its power of retaining water, 1 to 2 cu. yds. of the clay should be worked with water, by the usual methods, to a compact homogeneous plastic condition; and then a hollow should be formed in the centre of the mass capable of holding 4 or 5 gallons of water. After filling the hollow with water, it should be covered over to prevent evaporation, and left for about 24 hours, when its capability of retaining water would indicate its suitability or unsuitability for making puddle. In conclusion, the author desires to express his thanks to Mr. THOMAS WINDER, of the Duke of Norfolk's Estate Office, Sheffield, for valuable geological information, and assistance in consulting geological works for the preparation of this Paper.

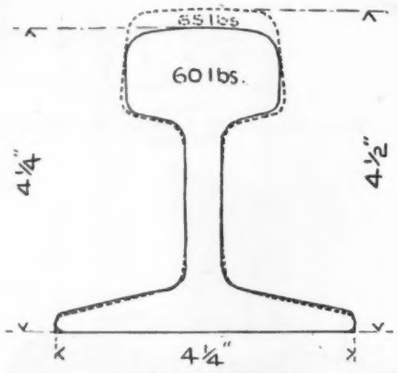
The Manufacture of and Specifications for Steel Rails.

At the October meeting of the American Institute of Mining Engineers, as was noted in our columns at the time, Mr. ROBT. W. HUNT, well known to many of our readers as having been prominently connected with steel rail manufacture from its beginning, read a paper on the manufacture of steel rails, in which he submitted the subjoined form of specification, and likewise gave some interesting points about the manufacture of rails which we abstract as follows:

The first steel rails rolled in America were six rails by the North Chicago Rolling Mill from steel made at Wyandotte, Mich., May 24-5, 1865. A few tons were rolled at the Spuyten Duyvil Mill in 1867. In August, 1867, the Cambria Iron Co. arranged with the Pennsylvania Steel Co., of Harrisburg, Pa., to roll their steel, pending the completion of their own mills. Of this rolling Mr. HUNT had charge. It was the first on a commercial basis in America, and in England the industry was still very young.

Extreme care was then used in all the processes of manufacture. Workmen were paid double as much per ton, the steel was worked comparatively cold, the rails were made with all the precautions of crucible steel. Break downs of the machinery were frequent, largely because of the greater resistance due to the cold steel, and the process was generally expensive, but most satisfactory in result. No one then dreamed that steel rails would ever become other than a costly luxury, and investments in plant for making them were cautiously conducted. *The Engineer* and *Engineering* even had for a long time a controversy as to whether steel rails were really the best, much as people fight now over the question of steel *vs.* iron for bridges.

Then came the overwhelming demand for cheapness. The makers were strenuously endeavoring to make good rails, but were confronted with the fact that an under-bid of 25 cts. per ton would usually take the order. The rails were soon rolled much better, and the process cheapened in every way possible.



Rail Sections.

Nevertheless Mr. HUNT enters the plea that there is less real contrast in quality than most people suppose, the supposed very high quality of the early rails being largely the effect of contrast and gratified surprise at it. We cannot follow him in this plea, since the records of actual removal show their great superiority, nor is the plea advanced with any great earnestness.

Mr. HUNT enters a special protest against deepening the heads of rails, making the head disproportionately heavy, with the supposed end of having more metal to wear away. He contrasts the two sections shown in Fig. 1, and claims that the metal in the larger head is so inferior, and is so much less effectively rolled (being necessarily quite hot when it leaves the rolls, that the thinner web and base may not be too cold) that it really has inferior wearing qualities to those of the smaller rail. He makes the same point in reference to the heavy 80-lb. or 90 lb. sections. We imagine that the point is well taken, and it is enforced by a contrast between two Pennsylvania rails, of almost identical chemical composition, tested by Dr. DUDLEY in 1880, one of which, of the smaller pattern illustrated had sustained 40,000,000 tons in 7 yrs. 11 mos. service with hardly half the total wear of one of the larger pattern, which had been in track 2 yrs. 11 mos. and sustained 21,500,000. Both were outside rails on a 5° curve, and laid quite close together. There was plainly an enormous difference in quality here, but whether it was wholly or mainly due to the section may well be questioned, nor do single rails prove much. A contrast between rails of equal age and make but different sections, would be more conclusive; but the complaint that unbalanced heads and bases led to poor quality has been general among rail makers, and if so it is plainly very poor policy.

It is insisted also that there is too much cold-straightening with the gag instead of hot straightening, and that taking out side bends by applying the gag to the flange is especially injurious. As to chemical composition it is said:

So long as the purchasers of rails exact a guarantee from rail makers, I think the chemical composition of the steel should be largely left with them. But if the purchaser believes that carbon is the best hardening element for steel, it is not unreasonable to ask for as much as the maker is willing to put in, knowing what proportions of other elements his metals will contain, and still guarantee his rails. No doubt as the sections are increased, harder steel can be safely used. The mere replacing of a broken rail with a whole one may fall far short of the damage sustained by the road in whose track the accident has occurred; leaving the danger to human life out of consideration. Therefore the purchaser has a right to insist upon some precautions being taken to avoid, as far as possible, such disasters. And these precautions, if correct ones, are also in the interest of the makers.

Steel rails are made very rapidly, and the demands of the trade necessitate that they shall be made very cheaply. The workmen are paid by the piece, and while generally making good wages, they must produce a large tonnage to realize them. No matter how desirous the general management may be of producing only good work, it is very necessary that safeguards should be provided. Most makers have these in some form, but there are mills where the chances are taken.

The tests which I prefer are those I used for 15 years at Troy. My experience gives me confidence in them. I do not wish to say that Troy rails have never broken in service, but such accidents have been very infrequent, and could almost always be traced to individual mechanical causes. This plan of making tests has the merit of furnishing a check on the grade of the steel early in its manipulation, and I consider it more convenient than any drop test, and at least equally efficient.

Mr. HUNT certainly speaks from the vantage ground of having been connected with works whose rails have been uniformly well above the average in quality: but he seems to trust over much to a guarantee.

The importance of correct handling of ingots, and especially of keeping them upright so as to maintain the funnel-shaped cavity at the top which is always formed in cooling, instead of having it distribute itself through the mass is also dwelt on, and also the danger of using a "bled" ingot (from the center of which molten metal has escaped leaving a cavity). It was probably such an ingot, we may infer, which caused the terrible White River disaster of two years ago, the metal never welding together, but leaving most dangerous longitudinal flaws in the heart of the rail which may not show at all on the exterior.

The now unquestioned fact that great differences in quality exist among rails of identical chemical composition and weight is dwelt on, and the following example given as one among many:

	Rail wore soft.	Rail wore hard.
Carbon	0.39	0.40
Sulphur	0.059	0.064
Phosphorus	0.085	0.080
Manganese	0.722	0.779

As to inspection it is said:

Every railmaker wants to give his customers good rails. Now I honestly believe it is to his interest that the purchaser should be represented by intelligent inspection. No matter how good the mill organization may be, the men all work by the ton, and do not always realize the importance to their own interests (which are the same as their employers) that only good work should go out. Hence the right kind of inspection is of assistance to any mill. If I were a purchaser of rails, I should draw fuller specifications than these, which I now have the honor to present to you, and I should accept all the risk of the results. But railroad managers are not yet willing to assume this position. I have therefore endeavored, while not relieving the makers of any responsibility or introducing novel practices, to assist the railroads in obtaining better and more uniform rails.

It is recognized as the commercial rule that railmakers should give a guarantee with their rails. In these specifications I have embraced such an one, as is given by some of the largest makers in the country, and under which they have sold rails for many years. It seems to me to be fair in its provisions, and I believe the other requirements of my specifications will tend largely in the direction of making the sellers safe in the guarantee. If this is so, the railroads will, of course, receive satisfactory rails, and everybody ought to be happy.

SPECIFICATIONS FOR BESSEMER STEEL RAILS.

SEC. 1. *Section.* The section of the rail rolled shall conform to the template furnished by the railroad company, with an allowance in height of 1-64-in. under, and 1-32-in. over, being permitted in a delivery of 10,000 tons of rails. The fit of the fishing or "male" template shall be maintained perfect.

SEC. 2. The weight of the rail shall be kept as near to—— lbs. per yard as is practicable, after complying with Sec. 1.

SEC. 3. *Lengths.* The standard length of rail shall be 30 ft. at a temperature of 60° Fahr. Shorter rails of —— length will be accepted to the extent of 10 per cent. of the entire order. A variation in length of ¼ in. longer or shorter than the above specified lengths will be allowed.

SEC. 4. *Finish.* The rails must be free from all mechanical defects and flaws, and shall be sawed square at the ends, and the burrs made by the saws carefully chipped and filed off, particularly under the head and on top of the flange. In sawing, care must be taken to avoid a flow of steel which will produce a swell on the top of lower flange, as the rail lays under the saw, thereby affecting the fit of the fish-plate.

SEC. 5. The rails shall be smooth on the heads, straight in all directions, both surface and line, and without any twist, waves, or kinks, particular attention being given to having the ends without kinks or drop. The hot straightening shall be carefully done, so that gagging, under the cold press will be reduced to the minimum, and so applied that the rails shall not be made "lumpy."

SEC. 6. *Drilling.* (Exact stipulations). These holes must be accurate in drilling in every respect, and left without burrs.

SEC. 7. *Branding.* The number of the charge, the name of the maker, the month and year of manufacture shall be marked in plain letters and figures on the side of the web of the rail in such a position as not to be covered by the fish-plates when laid in the track. If the purchaser prefers, the number of the charge shall be stamped on the end of the rail.

SEC. 8 *Per cent. of Carbon.* The steel to contain as high a percentage of carbon as the maker is willing to put in and still meet the requirements of Sec. 9 and 21.

SEC. 9. *Tests.* While the heat is being cast, two (2) test ingots shall be made. The first from steel going into the first regular ingot; the other from metal representing the last one. These test ingots shall be 3-in. x 3-in., and not less than 4-in. long. From them bars at least ½-in. square shall be drawn at one heat by hammering. Each bar when cold shall be bent, without breaking, by the blows of a sledge, to not less than a right angle. Should one bar from a heat fail and the other stand the test, a third bar may be taken from a bloom rolled from the same ingot represented by the failed bar. If this stands the tests, it shall be accepted in lieu of the failed one. If the makers choose, more than the two tests ingots may be taken, but they must be from the steel of the first and last regular ingots. If this is done and a test bar fail, another one may be drawn from the duplicate ingot and tested, and if it stands, accepted.

SEC. 10. *Treatment of Ingots, etc.* After the ingots are cast, they shall be either constantly kept in an upright position until ready to be rolled, or else so maintained until the interior steel has had time to solidify.

SEC. 11. No "bled" ingots, or ingots from "chilled" heats, shall be used in the manufacture of rails under this contract.

SEC. 12. No ingots from badly teemed heats shall be used, excepting as they shall be subject to the provisions of Sec. 16.

SEC. 13. *Cutting off Blooms.* After cutting off, or allowing for the "sand" or top end of each ingot, at least 12 in. more of seemingly solid steel shall be cut off that end of the bloom, or partially formed rail; if the latter, then the pieces so cut off shall equal 12 in. in length of a 7 x 7 in. bloom; a greater length than 12 in. being preferred; and if after cutting such length the steel does not look solid, the cutting shall continue until it does.

SEC. 14. *Heating.* Care shall be taken to avoid overheating the steel, in shape of either ingots or blooms, and under no circumstances shall a "cinder" heat be allowed; that is, heat high enough to cause the cinder to run off the steel as it is being drawn from the furnace. This does not apply to cinder which may be sticking to the under side of the steel, when drawn from a horizontal furnace, or to the bottom of an ingot, when drawn from a soaking pit.

SEC. 15. *Inspection.* Inspectors representing the purchasers shall have free entry to the works of the makers at all times while this contract is being filled; and shall have all reasonable facilities afforded, to satisfy them that the rails are being made in accordance with these specifications. The makers shall furnish them with the carbon determination of each heat, if so required.

SEC. 16. The inspectors shall have power to reject rails made from insufficiently sheared blooms, or from heats the test pieces of which have failed, or from badly poured heats, or from "chilled" heats, or from "bled" ingots. The rails made from uncut blooms, if otherwise perfect, to be afterward received as No. 1 short rails, if sufficient lengths have been sawed off to make an amount of steel equal to the original demand of 12 in. The rails made from heats, the test pieces of which have failed, may be accepted as No. 2 rails. The rails from a badly poured heat may be received as No. 2 rails; but if made from a "chilled" heat or "bled" ingot, to be absolutely rejected. By an imperfectly poured heat is meant one which from any cause has been teemed without the control of the operator. A "chilled" heat is one which, from the steel chilling, has to be either pricked or poured over the top of the ladle. A "bled" ingot is one from the center of which the liquid steel has been permitted to escape.

SEC. 17. Imperfectly drilled, straightened or chipped and filled rails shall be rejected, but will be accepted after being properly finished.

SEC. 18. Rails failing to comply with Sec. 1 will be rejected as No. 1 rails.

SEC. 19. *No. 2 Rails.* The requirements of No. 2 rails shall be the same as for the No. 1, excepting they will be accepted with a flaw in the head not exceeding ¼-in. and flaws in the flanges not exceeding ⅛-in. depth, and may have been made from an imperfectly poured ingot, or heats from which the test bars have failed.

SEC. 20. No 2. rails to the extent of——per cent. of the whole order will be received.

SEC. 21. *Guarantee.* The rail makers to guarantee the No. 1 rails against breakage and unusual wear at the ends or elsewhere for five years from the time of delivery to the railroad company; and should any such rails so fail, they will, upon the return of such failed rails to their works, deliver free of cost on cars at their works perfect rails to replace such failed rails, the failure of which is not attributable to improper laying or want of care after being laid, or unusual circumstances of derailment from failure of other railway machinery or appliances, or negligence of the railroad company's employés. In event of failure at the ends or elsewhere of the No. 1 rails, not exceeding 10 per cent. of the amount of the contract, before the expiration of the five years guaranteed (and when the rails in all other respects warrant such a course), the railroad company will cause to be cut off so much of such rails as may be necessary to make perfect rails of them, but in no case leaving them less than——ft. in length. The maker to pay in cash for cutting, redrilling and restraightening such rails. The loss in weight so sustained by the railroad company to be made up to them by the makers, on the return to them of the pieces so cut off, in good and perfect full length rails of such section as may be agreed upon. The points of delivery of failed rails, ends of rails cut off, and rails to replace the same, or mode of such settlement, may be varied to conform to the peculiarities of each contract.

It will be observed that no drop test, nor any other physical test whatsoever beyond that of bending over double ¼ sq. bars drawn out under the hammer from tests ingots is provided, and this, by Mr. HUNT's own assertions, will give a very inadequate test of the physical qualities of the rails themselves, which are by no means "drawn out under the hammer." We have ourselves known pieces from about hemushiest and poorest steel rails ever rolled to be so drawn out under the hammer and furnish a most excellent steel, almost like tool steel, and with an equally fine and close-grained fracture; thus going far to prove that the whole difficulty with the original rails lay in the process of manufacture *after* the ingots were cast, for which alone Mr. HUNT provides any test. The guarantee clause also seems to us a very mild and gentle one, leaving the buyer and not the seller to suffer the principal loss and inconvenience. We cannot therefore feel that these specifications are by any means all that might be desired, and that they should at least be supplemented by a drop-test of the actual rails; but Mr. HUNT's long and excellent experience entitles what he recommends to great consideration.

Silicated Iron and Steel.

Prof. J. B. JOHNSON, of Washington University has recently (Sept. 26, 1888) made a report on this subject to the Mullin's Silicated Iron & Steel Co., of St. Louis, Mo., from which we make the following extracts:

The specimens were brought to me in the rough, being 1¼ ins. in diameter and some 14 ins. long. They were turned down at the laboratory under my direction, tested on a Riehle 100,000 lb. testing machine, the working qualities of the metal observed and its appearance on the fractured surfaces noted. All tests and computations were made by me personally. With a very few exceptions, I was ignorant of the source and composition of the specimens, neither did I know which were silicated and which not, until after the tests were completed. No record of this information was kept by me, however, and you have to-day sent me the information which alone enables me to classify the results into "silicated" and "non-silicated," and also to determine which tests were on identical mixtures.

INTERNAL STRUCTURE.

This is shown by the fracture. Ordinary gray cast-iron shows a very fine granular structure near the outer surface of the casting, but this grows quite coarse and crystaline near the center of the section, especially if the thickness is as much as an inch or more. The silicated iron on the other hand, shows a remarkable uniformity of structure across the section, being close and fine-grained throughout. It appears more dense and more free from blow-holes and from the spongy structure generally found at the center of thick castings. If tested for specific gravity, or density, I believe it would show greater weight per cubic foot than ordinary cast-iron. Its structure would also lead one to predict a less shrinkage in cooling than ordinary iron, and if this is the case, then the internal strains which are caused by this excessive shrinkage, would be proportionately reduced. If it should prove to be true that the shrinkage is very much less than it is in other irons, as I am inclined to think is the case, then one very serious objection to the use of cast-iron in heavy masses, and in complicated forms is removed. At present cast-iron cannot be used in many instances where its use would be extremely economical and desirable, on account of the unknown weakening effect of these internal strains, caused directly by the excessive shrinkage in cooling.

WORKING QUALITIES.

Almost without exception, the silicated specimens have worked well in the lathe. They have been soft and tough many of them remarkably so. With the exception of a few mixtures of car wheel iron, which would be classed as "hard," all the silicated specimens submitted to me have possessed practically perfect working qualities.

TENSILE STRENGTH

I have made in all 74 tests of tensile strength, 43 of which have been on silicated cast-iron and 31 on non-silicated iron. In only 14 cases were the mixtures identical, except for the silicated treatment. In the other instances the silicated process was applied to cheaper mixtures, and the products compared with the standard output of the foundry. These test specimens are said to have come from 13 different foundries.

A fair comparison of results, to show the effect of the process, can only be made, therefore between the silicated and non-silicated mixtures which were otherwise identical. Comparing the results of these, we obtain the following averages:

Tensile Strength of Identical Mixtures.

Total number of tests	28
" " " silicated 14, non-silicated	14
Average tensile strength of silicated iron, lbs. per sq. in	25,400
Average tensile strength of non-silicated iron, lbs. per sq. in	20,720
Average excess of silicated over non-silicated, lbs. per sq. in	4,680
Average percentage of increase, lbs. per sq. in	22.6
Maximum strength, silicated, lbs. per sq. in	23,570
" " non-silicated, lbs. per sq. in.	24,530
Minimum " silicated, lbs. per sq. in	19,760
" " non-silicated, lbs. per sq. in.	16,550

The greatest increase of strength was from 19,410 to 28,800, or an increase of 48 per cent. The least increase of strength was from 23,500 to 24,500, or an increase of 5 per cent., as a result of the silicated treatment, the mixtures otherwise remaining the same.

If we take an average of all tests made, simply dividing the silicated from the non-silicated, without reference to character of mixture otherwise, but remembering that a large proportion of the silicated specimens were from inferior grades, while nearly all of the non-silicated specimens were from the selected runs of the shops, we have:

Tensile Strength—All Mixtures Included.

Total number of tests	74
Number of silicated specimens 43, non-silicated	31
Average strength, silicated, lbs. per sq in	25,500
" " non-silicated, lbs. per sq. in	22,600

No comparison can properly be made between these results, since the mixtures were not identical. The average strength of the non-silicated specimens given above (22,600 lbs. per sq. in.), is considerably higher than the average strength of cast-iron as used in our foundries. This general average would certainly not be over 20,000 lbs.; and possibly not over 18,000 lbs. per sq. in.

RESILIENCE.

This is a scientific term, not in common use, and may require some explanation. The resilience, or spring of a metal, is its ability to resist a shock, or blow. It is not simply its strength, but its ability to distort under a blow without breaking. It is the opposite of brittleness. Thus a very strong iron under a fixed load may be a very weak one under a blow. The force of a blow or shock is its energy, or *vis viva*, and is measured in inch-pounds. A body weighing 10 lbs. falling 10 ins., has an energy to 100 in.-lbs. in it. If it is stopped suddenly *something* must absorb, or take up this energy. If it falls on cast-iron, and cannot be itself distorted, then *all* this energy goes into the cast-iron. Since cast-iron breaks usually from shock, its *resilience, or ability to resist shock, is of much more importance than its strength.* I have computed the total resilience in inch-pounds per cubic inch of the metal. The resilience of cast-iron varies from 20 to 140 in.-lbs. per cu. in., the average grades of good cast-iron having a resilience of about 50 in.-lbs. per cu. in.

The resilience is found by carefully measuring the extension of the specimen for each additional thousand pounds stress, and from this data computing the number of inch-pounds per cubic inch of work, or energy, required to break the material. The apparatus used at Washington University is from our own design, and will measure the extension of the specimen to the nearest one ten-thousandth inch. It has not been customary to make these tests on cast-iron. Indeed, very few such tests have ever been made, but I regard them as many times as important as the tests for tensile strength. It is, in fact, the *only* real test of the ability of the iron to withstand repeated shocks of all kinds. Even the drop test is worthless for this purpose, since each blow weakens the piece an unknown amount, and the final blow therefore proves nothing.

As in the case of tension tests, it is only fair to institute a comparison between silicated and non-silicated mixtures, otherwise identical. Selecting these, we have the following average values of the resilience expressed in inch-pounds per cubic inch of the iron.

Resilience Tests on Identical Mixtures.

Total number of tests	16
" " silicated 8, non-silicated	8
Average resilience of silicated	107.5
" " " non-silicated	56.6
Excess of silicated over non-silicated	50.9 = 90%
Greatest resilience, silicated	140.0
" " non-silicated	111.0
Least " silicated	48.0
" " non-silicated	23.0

We may say, therefore, that the silicated process increased the ability of these eight mixtures of cast-iron to withstand shock by an average of 90 per cent., or it nearly doubles the strength of the iron, if it were to be broken by shocks or blows or any kind. Or, in common language we might say, it makes the iron more malleable.

If, now, all the resilience tests be arranged without reference to identity of mixture, we have:

Resilience Tests—All Mixtures Included.

Total number of tests	33
" " silicated	20
" " non-silicated	13
Average resilience, silicated	86.5
" " non-silicated	58.5

Here, again, we have included many tests on silicated specimens of cheap mixtures, which have lowered the general average, and, since the mixtures are not identical, no comparison can be drawn.

In conclusion, allow me to express my belief that your process greatly improves all the desirable qualities of cast-iron, and, so far as I am aware, aggravates no undesirable quality.

Professor JOHNSON is a very careful and competent expert in such tests, and we are confident presents an absolutely uncolored summary of his laboratory results. It would have been more satisfactory had the unsilicated specimens used for comparison been selected by wholly disinterested parties; but the "non-silicated" tests show for themselves that the iron was not very inferior and a large part of the tests will be seen to have been from identical mixtures. The process is a new one, the company having been organized only one year ago. They now state that "eleven of the largest iron manufacturing establishments in the United States have already taken licenses, signed contracts with us, and adopted the Silica process". The additional cost is stated to be only a few cents a ton. Especial attention is drawn to the fact that silica and silicon are two very different materials. The future of the process will be watched with interest.

SOUNDINGS about the Friendly Islands, by the English surveying ship *Egeria*, show depths of 4,295 and 4,430 fathoms or about 5 miles to bottom. These soundings which are in latitude 24° S. and longitude 175° W., are only exceeded in three spots in the world: i. e., 4,655 fathoms off the north east coast of Japan, found by the United States Ship *Tuscarora*, 4,475 fathoms, south of the Ladrone Islands, found by H. M. S. *Challenger*, and 4,561 fathoms, north of Porto Rico, found by the United States ship *Blake*.

AN ELEVATED RAILWAY bill is being considered in St. Louis, Mo. Among the names in the syndicate interested in it are those of A. BONZANO, DAVID REEVES and W. H. REEVES. This syndicate asks for a 99 year franchise, and agrees to pay the city $10,000 per annum for the first 5 years and $20,000 per annum thereafter.

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Drawings for publication *should preferably be in plain black and white, considerably larger than they are expected to appear, with letters and figures in pencil only, all lines clean and bold.*

Coming Technical Meetings.

Civil Engineers' Society of St. Paul, Minn. — Regular meeting, Dec. 3. Secy., Geo. L. Wilson, City Hall.

Engineers' Club of Kansas City, Mo.—Regular meeting, Dec. 3. "The Steam Engine; its Beginning, Growth and Place in the Industries of To-Day", C. A. Burton. Annual meeting, Dec. 5. Secy., Kenneth Allen, Y.M.C.A. Building.

Western Society of Engineers, Chicago, Ill.—Regular meeting, Dec. 5. Secy., L. E. Cooley, 171 La Salle St.

Engineers' Club of St. Louis, Mo. — Annual meeting, Dec. 5. Reports of officers and committees. "Condensers for Steam Engines", Prof. J. H. Kinealy. Secy., Wm. H. Bryan, 709 Market St.

American Society of Civil Engineers, New York.—Regular meeting, Dec. 5. Secy., John Bogart, 127 E. 23d St.

Civil Engineers' Club of Cleveland, O.—Regular meeting, Dec. 11. Report on Railroad Engineering. Secy., James Ritchie. Case Library Rooms.

New England Railroad Club.—Next meeting at Boston & Albany R. R. passenger station, Boston, Mass. Dec. 12.

New England Water-Works Association.—Regular quarterly meeting at Young's Hotel, Boston, Mass., Dec. 12. Secy., R. C. P. Coggeshall, New Bedford, Mass.

Engineers' Club, Philadelphia, Pa.—Regular meeting, Dec. 15. Secy., Howard Murphy, 1121 Girard St.

Engineers' Society of Western Pennsylvania, Pittsburg, Pa.—Regular meeting, Dec. 18. Secy., S. M. Wickersham.

Boston Society of Civil Engineers, Boston, Mass.—Regular meeting, Dec. 19. Secy., S. E. Tinkham, City Hall.

New York Railway Club.—Next meeting Dec. 20. Rooms 113 Liberty St., New York City.

JUDGING from our correspondence, a word to engineers seeking employment in Chili may not be out of season. The North and South American Construction Co. has already sent to Chili about all the civil engineers it wants, for the present at least. Under the concession the work of the American syndicate is constructive only; the engineering is altogether in the hands of the Government engineering corps of Chili; though we understand that one engineer on each piece of work will represent the syndicate interest. Responsible contractors are wanted, and skilled and common labor; but the billets for civil engineers are few, and these few are practically filled.

WE observe with great regret that the opposition to the construction of the Quaker Bridge dam is still active, and that they are not only securing a series of "public hearings" from the Aqueduct Commission (which is proper enough, since every man should be heard) but are succeeding in enlisting the *Tribune* and other papers on their side, and are making an effort to secure "expert" testimony in their support, a task which, we confidently predict they will find extremely difficult, if they seek "experts" whose attainments and experience really entitle them to be regarded as such.

It is a great pity that the daily press, which alone reaches the great mass of the public, and hence has an influence quite disproportionate to what they should have in questions of this character, will not either secure men who know something about such technical questions as this, or refrain from dogmatic assertions in regard to them. One peculiarly inane notion which seems to have impressed itself greatly on the *Tribune* and some experts like the Hon. O. B. POTTER, is that the Quaker Bridge reservoir will become a "stagnant pool" because its size forbids the water being very rapidly changed, and because a certain portion of the water is below the level of the aqueduct in-take. If this were so, then the Great lakes would be about the worst examples of "stagnant pools" on the globe, for the discharge over Niagara Falls is hardly more in proportion than a 6 in. pipe draining water from the proposed Quaker Bridge reservoir: while fully 98 per cent. of the water is below the level of discharge, instead of some 15 per cent. only. Nearly half of the volume of Lake Superior is in a sunless pool below the level of the sea, not to say below the level of discharge, where there is no reasonable probability of the water being changed in thousands of years; while if all supply was cut off and Niagara Falls were given the sole task of discharging the water now in the Great lakes, it has been calculated that it would take *a hundred years* to empty them by such a discharge.

ON the other hand the new aqueduct running at its full capacity would empty the reservoir in less than 100 days, or $\frac{1}{3.65}$ of the time stated. It follows (making some allowance for different rates of discharge per foot of diameter) that a pipe only

$$\frac{1}{\sqrt{365}} = \frac{1}{19}$$

as large as the new aqueduct would be required to parallel the insignificant discharging capacity of Niagara Falls Yet the arguments by which it is urged that it would be better to have a multitude of small reservoirs than one great one, would also go to prove that the water of the great lakes would be purer if they were divided up into some millions of little ponds, each of which in succession was emptied by the Falls.

The truth is, as we hardly need say in these columns, that (1) the water would be purer and better in every way if stored in one large deep reservoir than in many small and shallow ones; (2) that the "stagnancy" of the small per cent. of water (only 6 in 38 billion gallons) would do no possible harm at so great a depth below the surface, and (3) that there is not the smallest necessity for allowing any part of the water to be "stagnant", it being provided in the plans to draw water from an in-take near the very bottom of the reservoir, as is easily done

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A VERY important gain from so doing will be the more even temperature of the water; cooler in summer, warmer in winter. Part of this advantage will be lost through storage in the distributing reservoirs, but considerable will remain, and it should be an important gain to the comfort and health of the city, especially in the poorer sections; so great that arrangements might well be made to have the passage of the water through the reservoirs as direct as possible. The summer water supply of New York is now very warm, as every one who has compared it with the supply at Chicago, Cleveland and other Lake cities must have noticed. At the latter the water is not much too warm to drink at any season of the year; in New York it is so warm as to be offensive. The poor cannot indulge much in ice water, or certainly not habitually; and many a sick child's life must have been lost in consequence.

THE argument in favor of the dam is put very concisely and well in the elaborate Aqueduct report of 1887, especially in Diagram No. 1. For the past 17 years the average flow of the Croton has been, in millions of gallons, 135,401; the draught through the old aqueduct, 34,582, leaving the amount now going to waste, 100,819.

To save this great amount of water, storage is absolutely necessary, and the distribution of the supply through the year being now well known, it is easy to calculate what storage must be provided for any given *per diem* supply. There is now 9,210 million gallons of storage, which suffices for a daily supply of 250 million gallons. For 300 millions, there must be new storage of about 11,497; for 350 millions, 26,415; for 400 millions, 58,395, the total capacity of the proposed Quaker Bridge reservoir being 38,378, all in millions of gallons. The only remaining question is: How to get this storage. It is admitted that it can be done either by one large or many small dams, and it is unquestionably true that a less immediate expenditure would suffice for immediate needs, and more small dams could be added as needed; but it is intrinsically improbable that the aggregate cost of the small dams would be less than one large one, and it is claimed to be shown by estimates that they will not be. Whether they are or not, they will not be so good; and as the ultimate result, in order to obtain the maximum supply, will probably be the construction of most of the small dams as well as the large one, it would be the worst of bad policy to trifle with the plain requirements now, for the sake of postponing for a few years an investment of a million or two of dollars, if indeed even that be possible.

THE New York Board of Electrical Control, in suspending work on the subways for the winter, has a sorry record of results to show for a three years experiment in burying electrical wires. The board was created to meet an undoubted demand from the public to remove the "unsightly poles and dangerous wires" from the streets of our city. In attempting to meet this demand it has obstructed our streets and offended our nostrils for some years, in burying all manner of conduits, good, bad and indifferent, and the total result is about as follows:—Conduits planted with a total capacity of 30,000 miles of single wire, or quite enough to remove every conductor from the poles and the house-tops. But with this capacity, only about 6,000 miles of single wire are actually in the conduits, and of this not more than 600 miles are actually in operation, that is the lines of the Metropolitan Telephone Co. on Sixth Avenue. The Western Union Telegraph Co., the largest owner of wires in the city, is said to have not a single foot of wire in operation in any conduit built by the Subway Commission.

THE trouble is that the Commission, as constituted, did not know what was wanted in a proper electrical subway and seems to have taken little trouble to find out from other and expert sources. Like the steam-heating company, which they now charge with interfering with the efficiency of their downtown wires, they seemed to think that their first and last duty lay in burying "something" under the pavements, without the slightest attention paid to actual conditions or demands of ser-

vice. They have spent a lot of money for someone, and have made a general nuisance of themselves; and yet New York to-day has actually more wires strung along its streets than when they commenced operations, and the condition of our streets is worse than ever in having just so much more plant buried beneath the surface that will require constant tinkering and digging up, if it is to be in any way available.

AT the risk of repeating an old, old song, we must again ask when the wealthy city of New York will take steps toward the construction of substantial and permanent subways, for its wires, steam-heating and other plant of like nature? It is apparently too much to include water, gas and drainage systems in this disposal, though they all belong to the same category, and until they are so disposed of we must endure bad street pavements and suffer from the frequent breaking of their surface. But a decently constructed brick subway, that would be tight against leakage of surface water or gas, properly protect what is put in it, and yet allow entrance for repairs and connections, is neither beyond the reach of engineering skill nor of municipal finances, if both are intelligently and honestly applied. The money already expended in "not doing it" would go far towards building such a subway, on our main arteries of travel at least. And when down, there would be the satisfaction of knowing that some good was done; and the assured decrease in maintenance expenses would in time offset very materially the original greater cost. A little application of the old adage, that what is worth doing at all is worth doing well, would be seasonable in connection with this subway business.

SEVERAL correspondents have called our attention to the omission on our map of the Railway Systems East of Chicago, in our issue of Nov. 10, of the Lewiston division of the Pennsylvania system, from Sunbury to Selinsgrove Junction, Pa. The line was correctly given to us by Chief Engineer BROWN, but was omitted by the map engraver; an error which was not discovered until too late for correction.

Strains in Curved Dams.

We have received from Prof. I. P. CHURCH, of Cornell University, the communication which we give in full below, in which he suggests that there was "inconsistency" in our discussion of the above subject on Nov. 17. Premising that we hope to show in a few words that not only was there no inconsistency in the matters referred to, but that the letter is, as it certainly seems to us to be, a new illustration of the difficulty of getting applications in novel fields of the simplest engineering principles admitted, we give the letter as follows.

DEAR SIR:—In your issue of last week (Nov. 17) the editorial article on the design of the Quaker Bridge Dam seems to me to be open to the charge of inconsistency, as I shall try to show in the following manner.

Toward the foot of the second column of p. 389 you state that your criticisms on the report of the Board of Experts is made "on grounds quite independent of any arch action in a curved dam." And again, in the second column of p. 390, you claim to present a "correct method of analyzing the strains in a curved dam, which has no reference whatever to any possible arch action, etc."

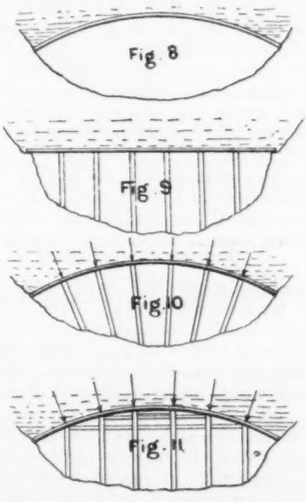
Now what is the essence of arch action in a curved dam, when such action is conceivable? It is the existence of pressures on the vertical radial plane sections of the mass of masonry; and the very reasonable argument of those who favor a straight dam, is, as has been often stated, that before the necessary elastic compression or closing up of the radial vertical joints (taking up the "slack") can occur, to evoke these pressures in an arch of considerable length and wide base, the radial laminæ begin to resist (and continue to resist if properly designed) by gravity action and thus the arch action is not produced.

In your Fig. 7 the long line of masonry *H H*, is expected, on your theory, to act as a strut; that is, to be subjected to compression in all of its sections. Is it any more reasonable to suppose that this state of stress (demanding, as it does, the taking up of the "slack" along *H H*), can actually be reached before the radial lamina *E D ac* begins to resist by gravity action, than in the case of the arch action just mentioned?

The conclusion must be drawn, then, it seems to me, that in Fig. 7 the resistance must still be computed for each radial lamina, on a gravity basis, precisely as in the case of a straight dam, or as in that of the curved form recommended by the Board of Experts.

I think that you have also overlooked another practical point bearing on the serviceability of the supposed strut *H H*, viz., that its vertical longitudinal section is not rectangular but shows a concavity on the upper edge.

To most concisely answer the questions herein we reproduce our figures 8, 9, 10, 11, in which the confusing, because unfamiliar fact of horizontality in an arch or curved dam is replaced by the familiar vertical type of arch; and we add as a premise that the "essence of arch action" is not in any sense nor from any point of view "the existence of pressure" on radial or any other planes of the mass. The "essence" of the arch action is the sustaining of vertical load without direct support, by the transformation of each vertical or normal pressure into two components *nearly* at right angles to it, and hence of much greater magnitude than the original force. It is not in any sense the "existence of pressure" through the curved mass, which may exist without any



arch action. Fig. 8 illustrates the true conditions for arch action, and Fig. 11, with the horizontal struts removed, one of many conditions under which there will be pressure in the mass without arch action.

We do not perceive that our correspondent has stated any more emphatically or distinctly than we did, the reasons why there cannot be any great amount of arch action in a gravity dam which is maintaining its stability as such, in the following words:

. "It is claimed, however, *and we believe with force and truth*, by those who advocate straight dams rather than curved, that a dam whose equilibrium is primarily due to gravity, cannot to any large extent be maintained at the same time by arch action, * * * as is outlined in Fig. 4; for the reason that * * * the gravity profile resists that horizontal yielding of the masonry which is absolutely necessary to generate the arch reactions *T*, Fig. 4, much as centering resists and forbids arch action in a vertical arch. We may support a load by an arch if we please, or we may support it directly, by props under the arch, but we cannot do both at once.

"This argument has been pushed to unjustifiable extremes by denials that there was, therefore, no arch action whatever in a curved dam, or that it might not become of great importance in case of partial or complete failure of the gravity stability, but in its essential features, we repeat, and have never questioned, it is a strong and sound one."

Passing this point; the mass *H H*, Fig. 7, to which our correspondent refers in his penultimate paragraph, corresponds to any one of the horizontal struts in Fig. 11, as will be seen by drawing horizontal lines across the ground plan in Fig. 13, which although a theoretical one, corresponds closely to the actual ground plan. Of this mass our correspondent says (and in the italicized words we judge to be his fallacy):

"*H H* is expected, on your theory to act as a strut; that is, to be subjected to compression in all its sections. Is it any more reasonable to suppose that this state of stress (demanding as it does the taking up of the slack along *H H*), *can actually be reached before the radial lamina begins to resist by gravity action* than in the case of the arch action just mentioned?"

There are no actual laminæ in the mass. It

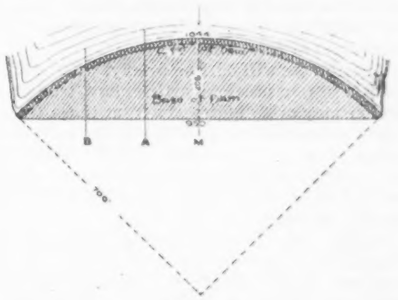


Fig. 13.

is practically monolithic. The only question is;—a precisely analagous question to that which comes up in a hundred different ways in bridge designing, where it has there become a well understood old story—shall we require a less aggregate of material by *considering* the mass as made up of radial laminæ, as in Fig. 10, or of parallel laminæ as in Fig. 11; and can we provide in either way? If so, which ever requires the least aggregate of material is the better way, and the strains will go in that way at least, if all others fail, because it is the direction best calculated to resist them. In this particular case, at least, there is no question that the method of Fig. 11, gives the thinner dam, if we provide for them amply in that way, and consequently, we are entirely at liberty to assume that the strains will go in that way and no other; since resistance by the mode of Fig. 10 would give greater unit pressures, hence lead to greater yielding, and hence in the end leave the strains to be resisted by the means we have provided in our design, unless our dam was so over strong that they happened to be resisted successfully in another weaker way.

The whole theory of modern bridge construction rests upon precisely this method of treating the path of strains. It took a long time to establish it, and it seems to bid fair to take as long to establish it as respects dams, but does not our correspondent see that his argument refutes itself? Supposing our dam designed to sustain the strains safely by the method of Fig. 11. The mass being monolithic, the strains may admittedly be resisted by the method of Fig. 10 if they chance to go so. They either will be so resisted or they will not. If they are so resisted without our intent, that is all we want. We need not borrow trouble by looking a gift horse in the mouth, and complaining our own horse is left alone to do the work. If they are not so resisted, then we have provided a way by which they will be. To provide a factor of safety of 2.0 by the methods of Fig. 11, necessarily involves a factor of 1.8 or 1.9 by the method of Fig. 10: Is it a true argument against Fig. 11 that our 2.0 stability never may in fact exist, because the 1.8 stability chances to be the one called into play (which it hardly could be) and proves all-sufficient? To state the claim is to refute it.

As to the possibility of pressure without arch action: Let our correspondent imagine a

straight dam like Fig. 13 inverted with the water on the straight side, made of bricks set on edge, with a piece of paper in front of it if he choose, to make it water tight: Will a transverse pressure through the bricks be arch action, or diminish the gravity stability? If not let him now shove them forward till the water face is curved and the dry toe straight (in plan) as in Fig. 13. The water will now introduce transverse pressure, but will there be any more arch action than before, or will the gravity stability of each brick be decreased? But if this principle be admitted, it means about 10 per cent. less volume in the curved dam 2-4 (Fig. 12 of Nov. 1) than in the straight dam 1, instead of nearly 12 per cent. more, as resulted from the combined errors of fact and theory on which we commented in our issues of Nov. 3 and 17.

But now we will outline briefly, what we did not do in our previous article, how true arch action may arise indirectly from these transverse pressures through the dam, independently of arch action from elastic yielding, which will certainly exist to the extent of say 5 per cent. of the total (a thing not to be despised, although it seems to be).

Consider the horizontal struts removed in Fig. 11; (*i. e.* assume the mass of the curved dam not capable for any reason of sustaining these strains); Each vertical post then tends to tip over, because it cannot resist the lateral resultant of the oblique normal pressure, and the *curved mass tends to rise in the center.* It surely needs no very profound knowledge of mechanics to perceive that this tendency to rise will be resisted by the pressure of superincumbent water, and that the curved rib will either buckle or transmit the resulting strains as a true arch thrust to the abutment. It is therefore unnecessary to consider the mass *H. H* of our Fig. 7 as a mere strut, although we have chosen to do so, to avoid appearing to adhere to extravagant claims as to arch action.

It only remains to add, as to the closing sentence of our correspondent's letter, that by referring to the ninth line of the first column of page 391, issue of Nov. 17, and reading thence six lines, he will find the practical point which he thinks has been overlooked, distinctly considered and provided for.

Chilian Notes.

The peculiar, long-drawn-out conformation of Chili and the scarcity of good harbors along the coast, about seven in 2,200 miles, makes a north and south trunk line of railway a most desirable feature of development; and this line is the ultimate end of the concession so lately granted to an American syndicate. A glance at the map of Chili, will show that such a line may have no unimportant bearing upon the future political history of Peru; in fact, it would be all important.

Chili now owns the strip of Bolivia that once bordered on the Pacific coast, and beyond that she now holds the provinces of Tacna and Arica formerly belonging to Peru. Under the terms of the treaty of Oct. 20, 1883, at the end of 10 years from that date, or in 1893, the vote of the people is to be taken and direct suffrage is to decide whether these two provinces are afterwards to belong to Peru or to Chili. In either case, the country to which this territory is to be annexed is to pay the other an indemnity of $10,000,000. Judging from the decidedly aggressive but generally wise policy of Chili and the methods of its rulers, the old Peruvian provinces will very probably vote for a transfer to Chili; and before that date arrives, a railway into that section will materially assist in spreading the Chilian gospel.

As the question has been put to us several times, by interested parties seeking information as to the financial integrity of the Chilian Government, we give some notes on this point from the latest accessible sources. In 1886 the imports of Chili amounted to $47,101,350, and the exports to $53,581,641; a total of $100,682,991, and an increase over 1885 of nearly $8,000,000. Mining exports came first in 1886 with $40,264,340, and agricultural products next with a value of $9,710,747. In 1887 the imports into the United States from Chili amounted to $2,863,233; and exports to Chili were worth $2,062,507. The Chilians last year abolished all import duties upon articles intended for mining and other industrial purposes. On Jan. 1, 1886, the public debt amounted to only $83,653,737, of which $33,733,500 was foreign indebtedness payable in gold. The home interest-bearing debt (3 to 9 per cent.) was $23,232,321, and the paper money in circulation amounted to $26,687,916. The report of the Minister of Finance, for June 1, 1887, showed that in 1886 the treasury received $65,764,588, including $14,652,331 surplus from 1885. The total expenditure in 1886 was $49,413,775, keeping on hand a surplus of $16,350,813.

While the progress in her financial standing among nations has been rapid and very marked since 1872, the present paper currency of Chili is only worth about 50 cts. on the dollar, figured on a gold basis. Since 1872 her foreign debt, payable in gold, has only increased about $6,000,000, and her home interest bearing debt about $7,000,000. But paper currency issued in 1880 and later to meet the demands created by the war with Peru and Bolivia, is still far below par, for reasons which are too intricate for statement here. In 1886 the Chilians succeeded in converting, at 98½, about $30,000,000 of foreign debt, of 4½, 5 and 6 per cent., into 4½ per cent. bonds. Her credit is therefore good in the money markets of the world.

The population of Chili, at the last census of Nov. 26, 1885, was 2,524,476. Chili was the first of the South American nations to introduce railways, and while Brazil, Peru and the Argentine Republic have a greater mileage, Chili still stands ahead in proportion to population. She has in operation about 9,000 miles of telegraph and 1,500 miles of railways, and 1,800 miles of railway are practically under construction. A gap of about 140 miles is now being closed, which will connect the Chilian and Argentine railway systems, and complete the first of the lines projected for crossing the South American continent. Chili has tramways in the streets of Concepcion; telephones in Santiago and Valparaiso and electric light in Coquimbo, all showing that country to be alive to the later improvements; and closer connection with the United States, by reason of the late concessions, will undoubtedly foster this spirit of progress and benefit both countries. In fact, as far as the government and the people are concerned, there would seem to be no reason for apprehension of any kind on the part of contractors or other parties from the United States who may contemplate business relations with Chilian enterprises.

But while Chili has generally pushed its national interests in a shrewd, business-like manner, and has wisely handled its finances, it should beware at the present moment of the railway concession fever that has seized upon its nearest neighbor, the Argentine Republic. This latter country, it will be remembered, in one short session of Congress conceded and guaranteed over 7,500 miles of railway, costing for construction about $290,000,000. And even under this heavy load for a rich and populous country—which Buenos Ayres can hardly yet claim to be—the public are not yet content, and the privileges asked from the present Congress represent an enormous amount of money a railway mileage which we fear is out of all proportion to the needs of the State, at present or even in the near future, and which are so evidently exorbitant and uncalled for that the Government has already adopted a conservative policy toward them.

The Greatest Railway Combination.

The year 1888 has seen the most widespread and destructive competition among the railway systems of the country which has ever been known. The fact that the Interstate commerce law, by its prohibition of the pooling of earnings took away the power of the Traffic Associations to regulate rates, was not thoroughly appreciated until the present year; during which the 12,000 miles of new railways built during 1887, a large proportion of which were built expressly to compete with older lines, have entered the lists to secure traffic and advertise themselves by cutting rates.

During the whole of this year, the question of questions with railway men has been how to bring rates back to a paying basis and not at the same time decrease income by the diversion of traffic to competing lines. The sections of the Northwest and Southwest where railway building has been most overdone, have suffered most by the war; but the trunk line traffic has also been involved and is at present in a most demoralized state. The presidents and directors of the leading companies are weary of the fruitless endeavor to maintain rates by mere agreement, which constitutes the basis of the Traffic Associations; and are at last convinced that it is useless to hope for permanent benefit without the adoption of more radical measures. And in this effort to raise their rates and ward off bankruptcy, public opinion is at last beginning to uphold them.

For the evil effects of the rate war reach beyond the railways themselves. The foreign holders of our railway securities are tired of their small returns upon them, and are beginning to throw them upon the market. This has already gone on to such an extent that exportation of gold has begun; while the continual reduction of railway dividends and the default in the interest on bonded indebtedness is begetting a lack of confidence in financial circles which has a depressing and dangerous effect on business of every sort.

The Southwestern roads are the ones which have suffered most severely; and for some weeks a conference has been in progress between President STRONG of the Atchison, Topeka & Santa Fe., JAY GOULD of the Missouri Pacific, E. F. WINSLOW of the St. Louis & San Francisco, COLLIS P. HUNTINGTON of the Southern Pacific, J. W. MIDGELY, Chairman of the Southwestern Freight Association, and a few other men equally prominent in railway and financial circles.

These conferences have resulted in the adoption of a plan for a combination of all the companies doing business in the territory bounded on the east by the meridian passing through Chicago, on the west by the western boundary of Wyoming, Colorado and New Mexico, on the north by an east and west line drawn through St. Paul, and on the south by the State of Arkansas.

The plan adopted provides for the establishment of a "clearing house" in which all the railway companies doing business within this area are to be represented. The objects of this clearing house are stated as follows:

"(A) To secure complete reports of all competitive traffic carried within the territory above described.

"(B) To prescribe the rates, rules, and regulations which shall govern in the conduct of the passenger and freight traffic as aforesaid, and insure their strict maintenance by all members.

"(C) To prescribe the character of the service and the conveniences which shall be offered the traveling and shipping public.

"The rates, rules and regulations shall be established by a Board of Managers, consisting of one accredited representative from each company member of the Clearing House.

"In case the members fail to agree upon any question brought before the Clearing House, it shall be referred to an Executive Board.

"The authority to make rates, rules, or regulations to apply in any traffic subject to the Clearing House carried by either road party thereto, or to change or depart from the same when established, shall be taken from the officers of the several railroads as such and be vested absolutely in the Clearing House.

"The division of all through rates of business included in the agreement shall be arranged through the Clearing House, the intention being that the business by means of private concessions shall cease, and that the divisions in corresponding traffic, under similar circumstances as to receipt and delivery, shall be open and alike *via* all lines.

"One officer of each road party to the Clearing House shall be held responsible for the strict maintenance of his or of all rates and rules established by the Clearing House, and he shall not be at liberty to depart therefrom unless by authority of the Executive Board."

Further provisions empower the clearing house officials to examine all accounts of each railway company in which the evidence of rate cutting may be hidden; and in case any officer of any company is found guilty of giving a rate other than that fixed by the clearing house, the Executive Board has power to discharge him.

In brief, the scheme takes from the separate companies all power to lower rates or give additional inducements for securing traffic, and vests the whole management, save the work of the clerical and operating departments, in the clearing house. The Executive Board is to be vested with supreme authority in carrying out the work of the clearing house, and it is stated that its Chairman will be Mr. J. W. MIDGELY.

The project has already received the approval of the presidents of the Southwestern systems, and is to be submitted at once to officers of the other companies in the area included. It is also reported that the agreement has been drawn to meet the approval of the Interstate Commerce Commission, who it is believed will lend their influence to its support, as Chairman COOLEY has looked with great disfavor on the cut-throat policy which has been pursued by railway managers during the past year.

We reserve extended comment upon this scheme until its particulars are more definitely known, as well as its prospects of practical execution.

This much, however, may be said: The inevitable tendency is for all railway competition to cease. Either by agreement, by submission to a central board of control, or by the actual consolidation of competing lines, competition in railway traffic is bound to be limited, checked or wholly wiped out. The business of railway transportation is by its inherent nature a monopoly, and all the laws and constitutional amendments that granger legislators can devise, which attempt to control railway rates by competition are destined to fail. In so far as these measures do work, they work to the injury of the public. Serious as have been the faults which have attended the attempts to regulate railway rates by State bureaus, that direction is the only one in which Government can beneficially interfere with railway traffic rates. It is by the harmonious work of such rate-fixing Commissions as the above scheme proposes on the part of the railways, and such rate-fixing commissions on the part of the Government as are necessary to protect the public from overcharges, that the true solution of the complex problem of railway rates will be found.

PERSONAL.

Prof. HILGARD, late Superintendent of the Coast Survey, is very low with Bright's disease. He is not expected to recover.

Gen. JOHN NEWTON resigned his position as Commissioner of Public Works of New York last week. Gen. NEWTON says that hereafter his duties as President of the Panama Railway will furnish him with sufficient occupation.

DAVID LOWBER SMITH, late Deputy Commissioner of Public Works, succeeds Gen. NEWTON as Commissioner, by the appointment of Mayor HEWITT, made on Nov. 26. The Mayor says that he offered the position to JOHN BOGART, State Engineer and Secretary of the American Society of Civil Engineers. But as Mr. BOGART could not be assured that he would be reappointed at the close of Gen. NEWTON'S term, May 1, 1889, he declined.

GEORGE LAYET, Controller of the Mobile & Ohio, died at Mobile, Nov. 22, at the age of 38. He had been in the service of the company 17 years, filling successively many positions including that of Auditor.

F. I. CABELL, formerly Engineer of Maintenance of Way of the Virginia Midland Railway, has been appointed Assistant Engineer on the Chesapeake & Ohio in charge of bridges under construction.

G. M. CUMMING, of the St. Joseph & Grand Island Ry., has resigned to accept the appointment as General Manager of the Western division of the Union Pacific Ry., with headquarters at Cheyenne, Wyo. His successor is E. MCNEILL, who from 1881 to 1885 was General Superintendent of the Shepaug, Litchfield & Northern Ry. He was afterward President of the same road.

A. L. HORNER, formerly Superintendent of the St. Louis, Iron Mountain & Southern Railway, and for the last year or two President of the Montrose Placer Mining Co. and Superintendent of the American Refrigerator Transportation Co., of St. Louis, has been appointed Superintendent of the Pacific division of the Northern Pacific Railway with headquarters at Tacoma, Wash. Ty.

CORRESPONDENCE.

Train Resistance in Cold Weather.

SUNBURY, Pa., Nov. 22, 1888.

EDITOR ENGINEERING NEWS:

In reference to the article on Train Resistance in issue of Nov. 17, as to increase of resistance in cold weather over warm: "TRAUTWINE" says, p. 215, "Every increase of 5° Fah. expands the bulk of any of them (viz. elastic fluids) slightly more than 1 per cent. of that which it has at 6° Fah., or 500° about double the bulk at zero. Assuming this, the resistant volume in front of the locomotive, from a fall of from 70° to 20° = 50°, would be increased 10 per cent. a corresponding increase of frictional resistance taking place on the sides of the moving train.

Very respectfully, FRANK COOPER.

[The point is well taken, and the difference in air resistance on this account is one which should certainly be taken account of, and goes far to account for a considerable decrease in hauling capacity at high speed, a larger one, in fact, than appears actually to exist. But on the other hand, it is to be remembered that it is only at speeds above 25 to 30 miles per hour that air resistance becomes considerable, if we may trust our summary last week of the C. B. & Q. and other tests.

The comparative weight of the air at any given temperature t, as compared with any other fixed temperature t', is given by the formula

$$W = \frac{t + 461}{t' + 461}$$

The comparative density D of air will be the reciprocal of the comparative weight, or:

$$D = \frac{1}{W} = \frac{t' + 461}{t + 461}$$

From the formulæ, taking 62° as the unit temperature for comparison, we have the following comparison of the density and weight of air (and hence relative air resistance under otherwise equal conditions, within the range of temperature experienced on this continent:

Temp. Fahr.	Comp. volume of air.	Comp. density of air.	Excess or deficit, p. c. of air resistance
−40°	.804	1.244	+24.4
−20°	.842	1.188	+18.8
0	.881	1.135	+13.5
+20°	.919	1.088	+ 8.8
62°	1.000	1.000	—
70°	1.015	.985	− 1.5
90°	1.054	.949	− 5.1
100°	1.073	.932	− 6.8

From this it appears that between 20° and 70° Fah. there is a difference of 10.3 per cent. and between the extremes of summer and winter, − 40° and + 100°, a difference of no less than 31.2 per cent., a fact which has not been as much considered as it should be, and perhaps accounts for the entire difference between summer and winter hauling capacity. ED. ENG. NEWS.)

Maximum Gradients on Electric Railways.

A correspondent having put to us some queries relating to the maximum gradients on electric railways, we referred his letter to the General Manager of the Thomson-Houston Electric Co., and the following gives the result of the extensive experience and practice of that company:—

Concerning gradients, we would say we can operate a car, up quite an incline; even 90° provided that if traction cannot be obtained, a suitable rack and pinion be used. In Allegheny City, for instance, gradients of over 12 per cent. are ascended by cars equipped with our 15 H. P. motors. But in this instance, as it was deemed unwise to depend entirely upon adhesion between wheels and rails, a special form of rack was attached to the side of the rail and one pair of wheels was provided with projections around its periphery serving as teeth. By this means still heavier grades could be ascended, and the question would then resolve itself into one of power. In Pittsburgh there is also another line where gradients of 15 percent and over are ascended, but in this case there is a rack in the centre of the track and a special toothed wheel is attached to the motor. There is no reason why a 20 per-cent. gradient could not be ascended with such necessary adjuncts, as on the Mount Washington road. We look upon it as purely a mechanical problem. Dependent upon adhesion alone, however, we would state that the portion of the Lynn & Boston tracks in Lynn, Mass., equipped by us, is an illustration of as heavy a gradient as we have yet ascended.

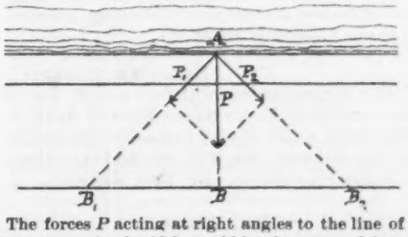
We think, however, that 12 per-cent. is as high as should be gone under the circumstances. In this case, also, we have taken the added precaution of placing on the truck extremely powerful track brakes; these act as an adjunct to the required wheel brakes. A 10% grade is easily ascended, and we have a number of roads in operation to-day that have such grades.

Straight vs. Curved Masonry Dams.

BROOKLYN, N. Y., Nov. 20, 1888.

EDITOR ENGINEERING NEWS:—

Allow me to ask, in connection with your editorial in ENGINEERING NEWS of Nov. 17, on the action of forces against curved dams, why a similar course of reasoning and similar resolution of forces could not be applied to a *straight* dam, with the result of a similar diminution of section and consequent proportional decrease of masonry needed?



The forces P acting at right angles to the line of dam, on a unit of width, could be decomposed into two forces at angles of 45° with P, having each a value of 0.7 (approximately) of P. The surfaces exposed to the action of P, and P_2 would be 0.7 of the unit exposed to P, and therefore the pressure per

lineal unit would be the same. The forces P, and P_2 being at right angles would act on sections at right angles with each other, and therefore, under your hypothesis, each section would be able to independently offer its gravity resistance to their action. Hence the area of sections on lines AB, and AB_2 would not need to be any larger than that previously assumed for the normal section AB, and thus the dam would be reduced to 0.7 of the previously determined thickness.

It is true that in the highest portion of the dam this would bring an excessive pressure on the toe, which would have to be provided for. But excepting for this short portion of the dam, your plea that the pressures on the toe are much less than the maximum could be availed of, and the necessary 0.414 added to them without making them exceed the maximum pressure assumed for the highest portion of the dam.

I do not wish to be understood as advocating such a decrease in the cross section of a straight dam.

J. T. FLAGG.

[For the same reason that the part $M\,N\,a\,c$ of Fig. 7, issue of Nov. 17, cannot be thus treated. Does our correspondent mean to assert or imply that there is any real parallel between the two cases? If so, we fail to follow him. He is at once increasing the toe pressures and decreasing the factor of safety against overturning throughout every part of the dam, neither of which was done in regard to anything suggested as to Figs. 12, 13, issue of Nov. 17. But if our correspondent still likes his method of resolution, he can do the same thing with the force F' acting on the curved dam, with a like showing of reduction beyond what we noted, but with the advantage which we have ignored throughout; that if his straight dam should tend to topple over because of his reductions, he has nothing to check the tendency, whereas a like tendency in the curved dam would be at once resisted by arch action. As such arch action can only come fully into play when the gravity stability is upon the point of destruction, it is proper to neglect it wholly in considering the proper section, as we have done; but it is *not* proper to ignore the fact that in case of extreme destructive forces, from an earthquake, dynamite or transmitted shock from failure of dams above (as to which we have received some interesting notes for publication) the arch would add from 30 to 100 per cent. to the *ultimate* resistance, and hence have that much better chance of remaining intact. ED. ENG. NEWS.]

Dealing with Quicksand.

EDITOR ENGINEERING NEWS:

Will you give in your journal an article on methods of dealing with quicksand in trenches and excavations for foundations, sewers, etc., and oblige.

C. H. W. WOOD.

[If some one sends it to us.—ED. ENG. NEWS.]

The Use of Cement Pipe for Sewers.

DENVER, Col., Oct. 29, 1888.

EDITOR ENGINEERING NEWS:

Can you refer us to any printed authority on the use of cement pipe for general sewerage purposes. If so you will greatly oblige.

Yours truly,

BARROWS & THREEWIT.

[Our correspondent will find a great deal of information in ENGINEERING NEWS of April 17, 1886, and a series of very extensive opinions in its first volume, 1874, if he can find the latter. It is now very scarce.—ED. ENG. NEWS].

Rail Braces.

BRADFORD, Pa. Oct. 13, 1888.

EDITOR ENGINEERING NEWS:

Where does the rail brace chair question stand today? Do first class roads use them on sharp curves to prevent the track from spreading? Does the combination of sharp curves, heavy grades, and high speed need their help to ensure safety?

I ask less for my own information than for a correspondent, part of whose letter I enclose for your perusal, who is in charge of some 350 miles of track, including two considerable stretches of mountain track with grades of 2.2 per cent. on tangents and with curves ranging as high as 10° 15′ in one case that I recall. He is much troubled, because despite all orders, trains run fast on these grades, track spreads, spikes are cut off at the neck, and trouble comes.

Yours truly, ROADMASTER.

[The letter enclosed is as follows:

"Some of the roadmasters on the * * * condemn the use of rail braces on curves. I asked for 1,000 rail braces to be placed on the sharp curves on the Boston and Winding Stair Mountains. You know the grades are heavy and the curves sharp and trains run down these mountains very fast. The braces add to the safety of the track 50 per cent. to keep it from spreading; besides they save the wear of spike, as in a very little while spikes get cut through at the throat. Now would it not be well to put an article in ENGINEERING NEWS asking the prominent engineers and trackmen of the country what benefit is derived by the use of steel or iron rail brace chairs on sharp curves and heavy grades when trains run from 40 to 50 miles per hour, if any, and whether they are really any benefit to track or not and if they ever knew an instance where rail brace chairs caused track to spread as asserted by one of the Frisco roadmasters."

[We shall be pleased to publish any of the evidences referred to, and in the meantime may say that there is no question whatever that rail-braces are a necessary and very effective precaution on sharp curves, and especially when the ties are soft. They are in almost universal use on first class lines, and we are much surprised that in such an extreme case as that quoted by our correspondent there should be any hesitation in using them.

The opposition there and elsewhere—what little there is of it—appears to be based on the mistaken notion that the only or chief purpose of the chairs is to prevent what is called "spreading of rails" suddenly, under a train. We have grave doubts whether they are of any use for this purpose, for the reason that we very much question if rails ever do spread in this way *before* a run-off, the spreading being rather an effect than a cause. But what the rail-braces do stop is the *gradual* spreading of rails by overturning, the outside edge "cutting" the most because of the greater pressure on that side, until finally the rails will often stand at an angle of 20° or 30° with the vertical, of course with a considerable increase of gauge, and a most dangerous decrease in the moment of stability of the rail, which under these conditions may overturn under a very moderate force. Rail-braces put an end to this tendency, and so aid greatly in keeping curved track in good shape.—ED. ENG. NEWS.]

PUBLICATIONS RECEIVED.

Technology Quarterly, (Mass. Inst. of Tech.); October, 1888. This number contains the following papers: "The Boiling Points of Naphthaline, Benzophenone and Benzol under Controlled Pressures", S. W. HOLMAN and W. H. GLEASON; "Experiments relating to the Theory of Beams" JEROME SONDERICKER; "Flow of Steam in a Tube", C. H. PEABODY and B. G. BUTTOLPH; "A Simple Calorimeter", C.H. PEABODY; "Heating Cars by Steam from the Locomotive", GAETANO LANZA; "The Biological Examination of Water", WM. SEDGWICK; "Critical Study of the Heating and Ventilation of the New Building, Mass. Inst. of Tech.", S. H. WOODBRIDGE; "Elementary Notes on Graphic Statistics", DAVIS R. DEWEY.

Transactions of the Technical Society of the Pacific Coast.—Sept.-Oct., 1888. This number contains minutes of meetings and papers on "The Copper Mines of Rio Tinto, Spain", by ARTHUR F. PRICE, and "Notes on the Walnut Grove Dam", by LUTHER WAGONER.

Alpine Engineering. by L. F. VERNON-HARCOURT, pp. 44.

Steam Engine Governors, by Prof. V. DWELSHAUVERS-DERY, pp. 23.

The River Clyde, by D. MACALISTER (abstract) pp. 6. Papers before the Institution of Civil Engineers.

Journal of the Association of Engineering Societies; November, 1888. Price 30 cts. "Transmission of Power by Belting", HORACE B. GALE; "Highway Bridges of Iron and Steel", J. A. L. WADDELL; Discussion on Highway Bridges; Memoirs of CHARLES LATIMER and W. L. BAKER.

A Simple Plan of Easing Railway Curves.—By WALTER SHELLSHEAR, Assoc. M. Inst. C. E. Paper read before the Royal Society of New South Wales. Pamphlet, pp. 10 5 cuts. A discussion of the use of the cubic parabola for this purpose.

Twenty-two Years of Protection.—By H. V. POOR, New York. H. V. & H. W. Poor. Pamphlet. pp. 222.

The Steam Boiler Catechism.—A practical book for steam engineers, and for firemen, owners and makers of boilers of any kind. Covering the properties of steam and fuels, and the theory and practice of designing, constructing, setting, connecting, testing, firing and repairing. By ROBERT GRIMSHAW, M.E., etc. Profusely illustrated, New York, 1888. Practical Publishing Co., Price $2

This is a companion volume to the Pump and Steam Boiler Catechisms by the same author; and like them is intended rather as a "handy reminder" than as a means of instructing experts in the construction or handling of boilers. It is practical, and handy, and it is fully worth the price to have it within easy reach when wanted.

Journal of the Franklin Institute, Nov. 1888. This number contains the report of the Committee on Science & the Arts on the Simond's Universal Metal Rolling Machine; "The Distribution of Internal Friction of Engines", by Prof. R. H. THURSTON, and "Electric Welding", by Prof. ELIHU THOMSON. There is a memoir of the late THOMAS USTICK WALTER, LL. D. Among the Notes and Comments is a paragraph on "The Protection from Rust of Railroad Rails in Active Service".

The Sewerage of Small Cities and Towns, being a paper read at the Lindsay Sanitary Convention and summer session of the Association of Executive Health Officers of Ontario, August 16, 1888, by WILLIS CHIPMAN, B A.S.C. Mem. Am. Soc. C. E. Mem. Can. Soc. C. E. Mem. Am. W. W. Assoc. and Mem. Assoc. Exec. Health Officers of Ont.

This is a small pamphlet of ten pages, containing notes on sewage; the necessity for its removal; the different systems of removal (giving many points in favor of the 'separate' system); and the approximate cost of construction.

A Manual of Land Surveying: comprising an Elementary Course of Practice with Instruments and a Treatise upon the Survey of Public and Private Lands. 3d. Ed. Revised and Enlarged. By Prof. C. F. R. Billows, Mich. State Normal School and F. Hodgman, C. E., Kalamazoo Pub. Co., Kalamazoo, Mich.

The revisions of this work are so extensive as to make it practically a new book, and as such we notice it. Its compilation was not wholly an individual enterprise, but more or less of the matter contained in it was the result of action taken by the Michigan Association of Surveyors and Civil Engineers in 1880, with a view to the better presentation of the legal and practical as distinguished from the mathematical side of surveying practice. A large amount of information relating to this side of surveying practice having been collected, it was determined to extend the scope of the work by including the necessary mathematical tables and details as well, and the result is a very valuable surveyor's pocket work, which should be in the hand of every surveyor in this country, and which every engineer likewise is likely to find useful.

The main features of the first part of the works are: 32 pages as to logarithms and trigonometry; 100 pages as to chain and compass surveying; 40 pages as to transit and stadia surveying; 24 pages on the solar compass; 17 pages on levelling; and 18 pages on drainage surveying. The last is a short but very practical article, and all this part of the work is well put together and practical, calling for no special remark. As geometry and optics remain the same there is nothing especially new nor especially superior to other manuals in this part of the work: neither is it inferior so far as our not very elaborate examination has indicated.

The next grand division of 134 pages is the heart of the book in every sense, devoted to a very careful summary of the legal and historical side of surveying practice, and dealing extremely well with those problems arising from resurveys of old land lines, discrepancies of U. S. and State practice, etc., etc. It is a very valuable and interesting compilation, an equivalent for which is not contained in any other treatise, on surveying, so far as we know. Section X, a compendium of judicial and other decisions as to "Resurveys" is especially valuable and complete. Section XI. on "Relocation of Lost Corners", and Section XII. "Miscellaneous" are also excellent.

After this department comes Section XIII. on "Subterranean Surveying", by H. B. STUBTEVANT, covering only 10 pages, and Section XIV. on "Curvilinear Surveying", giving in a dozen or so pages the main formulæ for running curves. Finally we have a brief summary of old Spanish and French measures, and another excellent and practical chapter on "Map Drawing and Lettering", by C. S. DENISON.

The volume closes with 106 pages of tables, among which we regret to again observe the abominable 6-place logarithmic tables for which American and English writers seem to have such an affection, although the rest of the world has long since found out, what every sensible man ought to be able to see at once, that a 6-place logarithmic table is something which ought never to be compiled or printed. Either 5-place logs. to 10,000 or 7-place to 100,000 should be used, and there is no room for anything intermediate between them, for the reason that, with either of these tables, the differences are small, and can be tabulated at the side and handled mentally, whereas the 6-place differences are exceedingly clumsy to use. It is easy, of course, to see how 6-place logs. originated; in the desire of strainers after precision to get the last degree of exactitude possible out of a 10,000 table; but the 7-place tables to 100,000 are vastly easier to use if great exactitude is desired, while if not, 5-place logs. afford all the necessary precision, and are vastly easier to use. It would be much more sensible in rough surveying computations if only 4-place logs. were used; and if such tables were readily accessible, logarithms would be used much more than they are.

The typographical "get up" of the book is excellent, except that the paper is rather thin. It is of form convenient for the pocket, and we have no doubt is, as a whole, a volume which will be much valued by surveyors, and engineers having an admixture of surveying practice. To all such we can cordially recommend it.

SOCIETY PROCEEDINGS.

Engineers' Club of Philadelphia.—Record of regular meeting, Nov. 17, 1888. Vice-President JOHN T. BOYD in the chair; 26 members and 4 visitors present.

The Secretary presented, for Mr. A. H. STORRS, a description of Poore's endless rope hoist for shafts. This system of hoisting is said to be particularly applicable to shafts of great depth. The advantages claimed are that it enables smaller engines to do the work, and effects a saving, as against the ordinary engines with drums, of about 50 per cent. in the first cost of the plant, and greatly decreases running expenses, owing to the much smaller steam consumption; the ropes, working altogether in straight lines, should be longer lived; and worn out hoisting ropes can be used for tail ropes; the cages run with less oscillation; the length of the rope is easily adjusted; and there is decreased danger of overwinding. The plant as put in at the Neilson Colliery of J. Langdon & Co., consists of a pair of 28x60-in. horizontal engines, with a pair of wood-faced rope sheaves and brake wheel, all 14 ft. in diameter, placed on the crank shaft. In addition to the regular brake for controlling the engines, an extra brake is provided with which the engineer can clamp the hoisting rope into the grooves of the engine sheaves in case of an emergency, such as the breaking of a rope. The tower head sheaves are 12 ft. in diameter. The hoisting rope is made of special steel, 1¼-in. in diameter, with a hemp center, and runs from one cage over the head sheave to one of the engine sheaves, thence to and around a transfer sheave to the other engine sheave, and over the other head sheave to the other cage. The cages are also connected by a 1¼-in. iron wire tail rope, running from the bottom of one cage around a small sump sheave at the bottom of the shaft and to the bottom of the other cage. This sump sheave hangs in the bight of the tail rope, and is free to move on vertical guides.

The transfer sheave, before mentioned, is a wrought spoke wheel above 16 ft. in diameter, so set that it can be moved towards, or away from, the engine sheaves, thus adjusting the length of the rope, and its position is always such that the lines of pull of the ropes are tangents both to itself and to the engine sheaves, thus avoiding any side wear on the grooves or rope. The total hoist is about 1,330 ft. The cages weigh three tons each and empty car about one and one-half tons. The cars carry from two and one-half to three tons of coal or rock. The cages, cars and ropes being perfectly balanced, the load in the car and the friction of the machinery is all that the engines have to overcome, and, as this load is constant all through the hoist, a steadier engine speed is obtained than with drums.

Mr. J. E. CODMAN presented a paper on "Indicator Cards from Compound Engines, Showing Expansion Through High and Low Pressure Cylinders", profusely illustrated by large copies of diagrams, etc.

Mr. A. MARICHAL discussed the plans of the Quaker Bridge Dam as proposed by the Board of Experts appointed by the New York Aqueduct Commission, and made comparisons between them and the plans presented by himself to the Commission at the beginning of this year.

Mr. MARICHAL says that the report of the Board of Experts contains certain errors of such a nature as to make it almost worthless; that this report represents his plans as to be built on a straight line, while four pages out of seven of the pamphlet accompanying his plan are devoted to demonstrating that the dam should be built on a curve. He moreover, says that he was one of the first to criticise the straight line in plan (See Proceedings, January 14th last). The author of the paper went into a mathematical demonstration, having for object to prove that the calculations made by the Board of Experts to ascertain the leverage, the frictional and the granular stability of the profile, were based on wrong theory; and that his profile, built on a curve of 900 ft. radius, would make a much stronger dam than the one proposed by the Board of Experts, and that the cost would be less by half a million dollars.

Mr. JOHN T. BOYD presented for discussion a sketch of a design for a stove for heating and steam purposes, which he had seen in operation and which generated an apparently immense amount of effective heat in proportion to the coal consumed.

HOWARD MURPHY,
Secretary and Treasurer.

Western Society of Engineers.—The 25d meeting was held in Chicago Nov. 14, Vice President JNO. W. WESTON in the chair. LEWIS PASSMORE PENNYPACKER was elected a member, and the resignations of A. M. KINSMAN, Rockford, Ill., and J. T. DODGE, Duluth, Minn., were accepted.

The Secretary read a letter from Prof. ALLAN D. CONOVER, University of Wisconsin, stating that a comprehensive system of tests of all the cements used in this country had been undertaken, and requesting information as to makers of cements and experience of members. After brief discussion, the Secretary was directed to communicate with Prof. CONOVER.

Mr. STROBEL, from the Committee on Bridges, made an extended progress report and the question of legislation was discussed for the views of the members. The correspondence with other societies showed a wide and active interest. The Committee will report formally with the draft of a bill at a future meeting. As legislation of interest to engineers, the Secretary presented the desirability of expanding the duties of the State Board of Health so as to require its approval of all plans for water-works and sewerage. A paper on "The Necessity of a Definite and Determinate System of Weights and Measures," by CHAS. C. BREED, was presented by the Secretary.

Mr. WESTON gave an account of a mammoth electric light plant now under construction in the city of London. A general discussson in regard to the application of any motor to direct propulsion on street railways then ensued. There was some doubt of securing adequate adhesion under all the conditions of track obtaining in crowded cities.

L. E. COOLEY, *Secretary.*

Engineers' Club of St. Louis.—The regular meeting was held Nov. 21, President HOLMAN in the chair; 31 members and 2 visitors present. The following were elected members: GRANT BEEBE, draughtsman, Pond Engineering Co.; EDMUND HALL, Asst. Eng., M. & O. R. R.; WM. S. LOVE, draughtsman, Union Depot Co.; WM. J. MCNULTY, Asst. Eng., St. L., I. M. & S. Ry.; R. L. VAN SANT, Asst. Eng., St. L. & S. F. R. R.; ARTHUR T. WOODS, Professor of Mechanical Engineering, University of Illinois.

A paper on "Smoke Prevention", was read by ROBERT MOORE. He showed that no saving need be expected, but that experiments showed a loss of 40 per cent. in boiler capacity when making no smoke. Most smokeless fuels cost too much, as compared with ordinary coal, to come into general use. In his opinion, the fuel promising the best results at reasonable cost was petroleum, already coming into extensive use. The increased cost of insurance and the odor, however, were disadvantages. Good results might be secured from that class of smoke preventers which introduced air above the grates by means of steam jets, provided no injury resulted to the boilers.

In the discussion Mr. BRYAN called attention to the fact that petroleum burners were being placed under boilers in St. Louis, and that it was expected that the increased cost would be justified by other advantages. He also mentioned furnaces at the Mississippi Glass Co. Works, fed by gas producers, where very high evaporative efficiency was reported. The general opinion of the club was that little could be expected in this direction. Mr. WHEELER stated that claims had been made that the soot particles were not only unobjectionable, but even remedial, from a sanitary point of view. Mr. BARTLETT gave the experience of the Olive St. cable line with jets of steam and air. They were successful unless the boilers were injured.

Mr. HOLMAN stated that serious injury to boilers had resulted from the use of steam and air jets, and he had therefore refused to allow such devices to be applied to the water-works boilers, which are internally fired. A proposition had been received looking to the use of petroleum, an evaporation of 14 pounds of water per pound of oil being promised. The increased cost of this fuel over coal would be small. I. A. SMITH stated that while in charge of public buildings at Cincinnati a smoke ordinance was passed, and he had used steam and air jets. These had since been removed, and after 6 years no reduction of smoke in that city was apparent. Prof. GALE was of the opinion that where steam plants of sufficient magnitude were used, gas producers would be found advantageous. There was, however, a lack of reliable data on this subject.

New England Water-Works Association.—The regular quarterly meeting will be held at Young's Hotel, Boston, Mass., on Wednesday, Dec. 12, 1888. A large attendance is anticipated. Members of Water-Boards are cordially invited to be present.

The programme is as follows: 11 o'clock; Meeting of Executive Committee. 12 o'clock; General Business Meeting. 1 o'clock; Lunch. 2 o'clock; Reading of Papers: "Construction and Management of Water-Works", Hon. CHESTER W. KINGSLEY, Cambridge, Mass.; "What is the Safe Ratio of Pumping Capacity to Maximum Consumption?", W. B. SHERMAN, C. E., Providence, R. I.; "Water in Some of its Higher Relations", Rev. D. N. BEACH, Cambridge, Mass.

HIRAM NEVONS, *President.*
R. C. P. COGGESHALL, *Secretary.*
New Bedford, Mass.

Arkansas Society of Engineers, Architects & Surveyors.—A meeting was held at Little Rock, Ark., Nov. 24. It having been suggested that the body might facilitate the building and improving of roads throughout the State, if a method was designated by which satisfactory work could be done at a small cost. JAMES A. MARTIN was appointed to draw up a paper in accordance with the views of the society. Capt. SIMONS, of the U. S. Signal Service was requested to prepare a paper on the meteorology of the State. The following papers were read: "The Municipal Improvements of Little Rock", by Major G. P. C. RUMBOUGH; "Timbers of Arkansas", by E. C. BUCHANAN; "The Plane Table", by D. C. B. AIKIN.

CONSTRUCTION NEWS.

RAILROADS.

East of Chicago.

Existing Roads.

Evansville, Suburban & Newburgh.—

EVANSVILLE, Ind., Nov. 12, 1888.

EDITOR ENGINEERING NEWS:—

Surveys are finished and the contract has been let for 5 miles of this road, which is to run from Evansville to Newburgh, Ind., a distance of 11¼ miles. Work is light and the maximum grade is ½ of one per cent. Most of the right of way has been secured, and about $45,000 in local aid. Subscriptions to capital stock have been made to the amount of $50,000, which will all be paid up in full, and the railroad completed without issuing bonds. The road will carry both freight and passenger traffic and will probably be ready for the rails by April 1, next. LU. HOWELL, of Evansville, is President, and B. A. WOOD is Chief Engineer.

W. J. WOOD, *General Manager.*

New York, New Haven & Hartford.—The advance sheets of the company's annual report show gross earnings for the year, $9,970,030, and operating expenses of $8,336,317. The surplus after paying a dividend of 10 per cent. was $83,719. During the year the company has spent $909,879 toward four tracking the road; $119,878 toward doing away with grade crossings; and for new station at Hartford, $112,834.

The report says: "The constantly increasing traffic of the company had outgrown existing facilities, and large expenditures have been made to meet the public demand for the best service. After the completion of the bridge at New London a double track on the Shore Line will be necessary. The New York division needs four tracks as soon as they can be provided. Grade crossings must be abolished, and passenger terminals improved even at great expense."

New York Central & Hudson River.—The rails are being taken up on the branch of the West Shore Railroad from Athens to Coxsackie, N. Y., 6.16 miles.

Port Huron & Northwestern.—The gauge of this Michigan road is to be changed to standard between Port Huron and East Saginaw, and a report has gained currency that the line was to come into the possession of the Canadian Pacific because:

"The completion of the tunnel under the river at Port Huron would enable this scheme to be easily carried out, for the Canadian Pacific would only have to construct a line from Komoka to Sarnia, a distance of 51 miles, or extend their track from London to Glencoe, and there connect with one of the Grand Trunk double tracks to bring that road at once to Sarnia. Reaching Saginaw by a line already built, they could easily make an extension westward, tapping the new Battle Creek and Bay City road, and by acquiring that line could push on to Chicago and St. Louis."

It need hardly be said that this is pure nonsense. The Grand Trunk company are building the Port Huron tunnel, and are not likely to allow the Canadian Pacific to get any benefit from it which they can help. As for the Canadian Pacific going to Chicago and St. Louis, when it does reach those points, it is not going round Robin Hood's barn by way of East Saginaw. It would seem unnecessary to call attention to this obvious canard if it had

not been circulated so widely by our most reliable exchanges.

New York, Mahoning & Western.—The latest news from this dejected enterprise is that two capitalists representing the American Midland company are negotiating for its purchase. If this is the same "American Midland," which has been in a chronic state of contemplation so long that its disease seems incurable, the much advertised Mahoning road has to carry insult as well as injury.

Grand Trunk.—The Beauharnois Junction and the Fort Covington & Massena Springs railways are now ballasted and ready for passenger traffic.

Boston & Maine.—President LORD states that the investigating committee, consisting of SAMUEL C. LAWRENCE, AMOS PAUL, FRANK JONES and G. C. LORD, has been appointed merely to ascertain where expenses can be reduced without detriment to the general service.

Fitchburg.—The annual report to the State Railroad Commission shows gross earnings to be $5,463,298; expenses, $4,196,605. This is an increase of $810,027 in net income over the previous year.

Canadian Pacific.—J. FRANCIS LEE, the Commercial Agent of the company at Chicago, announces that the company has secured an entrance to Chicago by a trackage right over the Wabash Western from Detroit, and will be running its trains into Chicago within a year. A wild report that it was to secure a line from St. Paul to Chicago he stated was wholly unfounded.—At the special meeting of the company at Montreal, Nov. 23, it was voted unanimously to lease the West Ontario Pacific extension, now under construction from London, Ont., to a point opposite Detroit. This settles the building of the line, and it will be pushed through as fast as possible.

Baltimore & Ohio.—The annual report, which was made public last week, gives a more detailed exhibit of the company's affairs than has been made for a long time. The revolution in the methods of book-keeping by which the famous surplus fund was cut in two and brought down to an honest basis is generally commended; and the removal of the doubt and uncertainty which has enveloped the affairs of the company since the time of the crash in 1887, has had a salutary effect on the price of the stock. The sound business policy which President SPENCER has adopted, is recognized by the principal holders of the company's, securities, including the Drexel-Morgan syndicate. The report as a whole is so clear and explicit that unlike the usual reports of railway corporations, it is very interesting reading.

New Projects and Surveys.

Columbus, Lima & Northwestern.—

LOCK BOX 286, LIMA, O., Nov. 14, 1888.

EDITOR ENGINEERING NEWS:—

The Columbus, Lima & Northwestern Railway is to run from Boutwell, Ohio, *via* Columbus, Bellefontaine, Lima, Defiance, Bryan, Kalamazoo, (Mich.) and Allegan, to Saugatuck, on Lake Michigan, a distance of 306 miles. The line runs through the very best of farming country, and will secure a heavy traffic in coal, coke, lime, building stone, oil and farm products from the south, with lumber and iron ore from the north. There will be two small tunnels and no large bridges. Surveys are about completed and local aid has been mostly secured on the basis of $3,000 per mile. The greater part of the right of way is also obtained and negotiations are now pending for bonding the road. The line is wholly independent and it is certainly a meritorious enterprise as it has no parallel line from Columbus to the lakes. Negotiations will soon be opened for the construction and equipment of the road. B. C. FAUROT, Lima, O., is President; SAMUEL CRAIG is Chief Engineer; F. P. LANGAN of Lima is Treasurer. F. P. GRAF, *Secretary.*

Maine Shore Line.—

MACHIAS, Me., Nov. 21, 1888.

EDITOR ENGINEERING NEWS:

This company, which was chartered in 1881, proposes to extend its line from Hancock to Calais, Me., a distance of 93 miles, with a branch to Eastport, 16 miles, making the total length 109 miles. The whole line has been thoroughly surveyed, about 30 miles located, and 2½ miles graded. The maximum grades are 1½ per cent. There will be a large bridge with draw at Sullivan, with about 600 ft. of waterway, requiring 13 spans of from 80 to 170 ft., which will be of iron. The line is projected in the interest of the Boston & Maine, Maine Central, and Grand Southern of New Brunswick railways, furnishing a short route to St. John. Very advantageous traffic contracts have been made with the first two of the above companies, covering 1,200 miles of their systems. Right of way has been secured for 12 miles and $100,000 of local aid has been obtained. JOSEPH N. GREENE, *President.*

Scranton & Forest City.—A charter was granted at the State Department at Harrisburg on Nov 21, to this railway, with a capital of $220,000. The line will be 22 miles long.—*Railway World.*

Sandusky, Ashland & Coshocton.—This Ohio project is again being agitated. W. D. CRANE, 45 Broadway, New York, is obtaining funds at Sandusky to purchase the right of way from there to Milan.

Kinderhook, Valatie & Stuyvesant.—This enterprise, of which CHAS. D. HAINES, 45 Broadway, is President, is said to have been consolidated with the proposed Columbia & Rensselaer, mentioned last week, and the prospects are that the road will be built the coming season.

Vincennes & New Albany.—

VINCENNES, Ind., Nov. 22, 1888.

EDITOR ENGINEERING NEWS:—

Surveys have been completed for this road from Vincennes, Ind., *via* Petersburg, Jasper, French Lick, Paoli, Fredericksburg and Galena to New Albany, a distance of 126 miles. The southern part of the line runs through a hilly and timbered country and will require some rock work. From Jasper north the country is level. The line will have a considerable coal and timber traffic, besides that secured by advantageous connections in all directions. Right of way is ⅔ secured and local aid has been given to the amount of $350,000. Contract was awarded to Bullock & Co., of New York City, who has assigned to First National Bank, and Post & Martin, of New York, and R. D. Woods & Co. and W. G. Hooper & Co., of Philadelphia, who are expected to complete the road. They will probably let subcontracts. C. DELEFIELD, is Chief Engineer. EDWARD WATSON, *President.*

Utica, Adirondack & Saratoga.—

Main Building,
UTICA, N. Y., Nov. 19, 1888.

EDITOR ENGINEERING NEWS:

The preliminary survey is completed for this road which is to run from Prospect to Nobiesboro, N. Y., a distance of 21 miles. Maximum grades will not exceed 60 ft. per mile. There will be one large bridge at Gang Mill. About one-third of the right of way is secured, and it is expected that matters will be in shape to commence grading in the spring of 1889. The company was chartered May 5, last. RICHARD W. SHERMAN is Chief Engineer.
H. J. COOKINHAM, *President.*

SOUTHERN

Existing Roads.

Augusta & Chattanooga.—This company has been in financial difficulties for many months on account of an unpaid bill for grading on the line, done by W. B. Lowe & Co. On Nov. 21 the suit was settled by the payment of $16,000, and this has given rise to a surmise that the money to settle the debt was furnished by the Cincinnati Southern company, who are supposed to desire a line to the Atlantic seaboard. The rumor, from all appearances, is entitled to no credence.

Versailles & Midway.—Tracklaying is in progress on this Kentucky road, and will probably be completed to Midway by Dec. 1, and by the 15th regular trains will be running between Versailles and Georgetown.

Knoxville, Cumberland Gap & Louisville.—General Manager GEO. R. EAGER states that tracklaying is to begin at once from Knoxville north, as 35 miles are now ready for the rails. Work on the Knoxville Southern is making good progress, and contracts will soon be let for the heavy work on the line. The Cumberland Gap tunnel is being driven steadily along, and will be completed within the specified time.

Gulf & Ship Island.—It is stated that some work is still being done on the line between Hattiesburgh, Miss., and the coast. It is proposed to extend the line from its northern terminus to Jackson, Tenn., and surveys are to be made at once.

Western & Atlantic.—A bill is now pending in the State legislature to lease this road to the Atlantic, Atlanta & Great Western Railway Company. The bill is opposed by the Atlanta & Florida company, who wish to secure an equal interest in the lease.

Cape Fear & Yadkin Valley.—On the Madison branch of this North Carolina road, about 9 miles of track has been laid. Grading is making good progress on the Wilmington extension.

Carolina, Knoxville & Western.—This line is graded to a point within 9 miles of Brevard; and track is laid to Marietta, S. C.—The Georgia Construction Co., which is building this line, is again in financial straits. Contractors' liens have been filed against it to the amount of $83,000. The company will be reorganized at once. There will be a delay in construction on account of the trouble, but the financial stability of the railroad company is said to be unaffected.

Georgia, Southern & Florida.—This Georgia road will be finished to Valdosta by Dec. 1.

Central Railroad of Georgia.—A petition for the appointment of a receiver has been filed by the minority stock holders of the Port Royal & Augusta railroad.—Judge SPEER of the United States Circuit court has just ruled that the company had no right to purchase the Savannah, Dublin & Western railway, as it was a competing line to its own, and the consolidation was against public policy. The case will be appealed to higher courts, who it is to be hoped will reverse this unwise decision.

Tennessee & Ohio.—This line, which extends from Rogersville Jc., Tenn., to Rogersville, 16 miles, is to be extended to Big Stone Gap, Va., 45 miles, at an early date. H. M. AIKEN of Rogersville is President.

East Tennessee, Virginia & Georgia.—The suit to prohibit the lease of this company to the Richmond & Danville, which has been pending before Chancellor GIBSON at Knoxville, Tenn., has been decided in favor of the Plaintiff. An order is issued restraining the company from approving or ratifying the lease or yielding its property to the Richmond & Danville company. It is reported that the suit was instigated by the Norfolk & Western Company. The nullification of the lease, however, will not greatly affect the relations of the company with the Richmond & Danville, as that company owns the first preferred stock of the E. T. Va. & Ga., which controls the company.

Richmond & West Point Terminal.—It is reported on good authority that Jay Gould is quietly securing large holdings of the company's stock and is likely ere long to have an influential voice in its management. The object is supposed to be to unite for purposes of competitive traffic, the Missouri Pacific and Richmond Terminal systems, which touch each other at Memphis, Tenn.

Atlantic Coast Line.—The annual meeting of the Wilmington & Weldon company was held at Wilmington on Nov. 21. The President gave an account of the construction work under way and recently completed. The Scotland Neck branch has been extended from Scotland Neck to Conehoe creek, 12 miles, and grading is completed to the Albemarle & Raleigh R. R., 12 miles farther, to which point rails will be laid by the end of the year. Contracts have been let from this point to near Greenville. The Wilson & Fayetteville branch has been finished from the State line toward Fayetteville, a distance of 3 miles. On the Manchester & Augusta railroad from Sumter, S. C., west, 14 miles are completed and 4 miles are under contract. The Chowan & Southern Railroad from Portsmouth to Tarboro, with terminals at Norfolk, is being built jointly by the company with the Richmond & Danville company, and a large force of hands are pushing the grading.

Richmond & Petersburg.—At a meeting of the stockholders of this company at Richmond, Nov. 19, are solution was adopted authorizing the construction of a belt line around the city connecting the line with the Fredericksburgh & Potomac. The line will be 3¾ miles long and will cost $375,000.

New Projects and Surveys.

Anniston & Montgomery.—A bill is before the Alabama legislature to incorporate this company to build a railroad between the points named. JOHN B. REES, W. S. LARNED, F. M. HIGHT and JOHN W. NOBLE, of Anniston, are the incorporators.

Alabama & Georgia.—This company has asked for a charter in Alabama to build a railroad from the Georgia State line to Center, Ala. GEO. P. SMITH, ROBERT R SAVAGE and others are the incorporators.

Cumberland Mountain Coal & Railroad Co.—This Tennessee company proposes to build a railroad from a point on the Cincinnati Southern to the navigable waters of the Clinch river. Among the incorporators are BENJAMIN W. BRADFORD, WM. A. HENDERSON and REUBEN A. DAVIS.

Paducah & Tennessee.—Calloway county, Ky., has subscribed $50,000 to the stock of this road.

THE NORTHWEST.

Existing Roads.

Winona & Southwestern.—The 20-mile division on which track has just been laid was celebrated by an excursion from Winona on Nov. 23. The line is located with a maximum grade of 1 per cent. Construction is still in progress from the end of track.

Cairo, Vincennes & Chicago.—A charter will soon be granted to JOHN MCNULTA, Receiver; K. H. WADE, General Superintendent; WILLIAM HENSIL, Chief Engineer; G. W. STEVENS, Division Superintendent; J. M. OSBOURN General Freight Agent of the Wabash Railway, and M. A. MCDONALD, General Manager of the Cairo & Vincennes Railroad, for the construction of a new line, 64 miles long, from Danville to Strawn or some point near there, on the Chicago division of the Wabash Railway. The principal object of the new line is to be a cut-off from Chicago in consigning coal from the Indiana and Illinois fields to the Northwest. In connection with Mr. MCDONALD'S road it will make a new Chicago and Cairo route. Preliminary lines are now being run.

Minneapolis & St. Louis.—A crossing war, with its usual ludicrous and silly accompaniments, occurred at North Minneapolis on Sunday, Nov. 25, between this company and the St. Paul, Minneapolis & Manitoba.

Duluth & Winnipeg.—It is hoped to lay 20 miles of track on this road before winter sets in.

Burlington & Missouri River.—The extension of the line in central western Nebraska, which is being pushed west to reach the Wyoming coal fields, is reported in progress.

St. Paul, Minneapolis & Manitoba.—It is reported that the company has surveying parties at work near Pelican Lake, north of Brainerd, Minn.

New Projects and Surveys

Minneapolis, St. Paul & Southwestern.—A charter has been filed in Minnesota for a road by the above name, which is to run in an air line from the Twin Cities, *via* Des Moines, Ia., to Kansas City, a distance of 437 miles, or 125 miles less than the shortest existing railroad. This company is the successor to the St. Paul & Southern, which has been making surveys for a year or more between Minneapolis and the Iowa State line. C. C. GARLAND of Minneapolis is President of the company and among the directors are B. WARNER TAYLOR, CARMEN N. SMITH and F. D. WOODBURY of Minneapolis; and THOS. BOHEN, JOHN C. WHITE and WM. G. WARD of Waseca, Minn. It is stated that, "these capitalists represent a pledged capital stock of $15,000,000." But it can be pretty safely stated that no one who is the happy possessor of $15,000,000, is going to invest it in another railroad in the Northwest at present.

Canada, La Crosse & Southwestern.—The annual meeting of this company was held at La Crosse, Wis., on Nov. 22. F. A. ROZIENE, Charles City, Ia., was elected President; S. S. BURTON of La Crosse, was elected Treasurer; and R. CALVERT, Secretary.

St. Paul, Black Hills & Pacific.—The preliminary survey of this Dakota road has been completed from Mandan to Rapid City. An interesting statement has been published, that among the promotors of this enter-

prise are Col. DANIEL LAMONT, CALVIN S. BRICE and SENATOR HEARST.

Kearney, Broken Bow & Western.—At a recent meeting of the Board of Trade of Broken Bow, Neb., a committee was appointed to visit Kearney and interest the citizens of that place in the project for a railway from Kearney to Broken Bow.

THE SOUTHWEST.

Existing Roads.

Kansas.—The State Railroad Commission has compiled the following report of railway construction for the current year.

Company	Number miles built in 1888.	Number miles operated in State.
A., T. & S. F.	40.26	2,586.84
Bur. & Mo. R.	38.74	259.15
* Chi., Kan. & Neb.	134.70	1,055.70
† Dodge Cy. Montezuma & Trinidad	51.	51.
Kan. Cy., Ft. Scott & Mem.		256.90
Kan. Cy., Clinton & Springfield.		23.10
Kan. Cy., Wyandotte & No'w'n	25.	157.
Kan. Cy. & Pac.	32.	125.
Mo. Pac	82.	2,179.
Mo., Kan. & Tex.		254.
St. Joseph & Grand Island.		138.
St. Louis & San Francisco.	10.54	437.84
Union Pacific.	130.91	1,151.23
Wichita & Western.		124.40
Total	545.15	8,799.16

* Does not include right of way over Union Pacific track, Kansas City to Topeka.
† Twenty-seven miles now built, balance by Dec. 31.

Cleveland, St. Louis & Kansas City.—A considerable force is now at work on the grade between St. Charles, Mo., and the site of the Mississippi River bridge opposite Alton, Ill.

Kansas City & Southern.—The line is now ballasted and in good condition for business for the whole distance from Kansas City to Osceola, Mo., 114.27 miles, and will be formally opened for traffic on Dec. 1. W. GRAY, the newly appointed General Manager, has decided to locate the general offices of the company on the fourth floor of the Gibraltar building in Kansas City.

San Antonio & Aransas Pass.—About $75,000 local aid has been raised to further the building of the proposed extension from Comfort to Llano, Tex. An attempt is being made to raise an additional $75,000 from the citizens of San Antonio.

Southern Pacific.—Ricker, Lee & Co., of Galveston, who have the contract for grading the extension from Victoria to Beeville, Tex., have the road ready for the tracks from Victoria to the San Antonio river, a distance of 26 miles, leaving 29 miles still to be graded.

Memphis, Little Rock & Indian Territory.—It is reported that a considerable amount of grading has been finished on this road near Hot Springs, Ark., and surveys are being made toward the Indian Territory line.

Atchison, Topeka & Santa Fé.—It is authoritatively stated that the Southwestern systems have entered into a traffic combination of a different sort from any ever before tried, and that rates are now to be advanced and maintained. A rumor that the directors of the company intend to ask for President STRONG'S resignation is generally believed to be without foundation.

Arkansas Midland.—It is announced that the litigation between the present management of this company and the English holders of its securities has been concluded, and the line will be pushed on to Little Rock at an early date.

New Projects and Surveys.

Hackett City, Greenwood & Eastern.—

GREENWOOD, Ark., Nov. 20, 1888.

EDITOR ENGINEERING NEWS:—

This company was chartered Sept. 19, 1888, and proposes to build a railway about 25 miles in length, passing for its whole length through a valley underlaid with a seven foot vein of coal, now being worked in several places. This coal deposit will furnish the principal traffic for the road, and is the chief cause of the enterprise being taken up. The charter members are of the best and wealthiest citizens here and own most of the coal lands along the line. Surveys have been made and right of way is all obtained. ROBT. H. MCCONNELL, of Greenwood, is President of the company. JAS. E. JOHNSON, *Chief Engineer.*

Hiawatha & Harlan.—A scheme is being discussed at Hiawatha, Kan., for a railway to Harlan *via* Baker and Willis. The preliminary steps for securing a charter have been taken. We believe this means in Kansas that the "prominent capitalists who are behind the enterprise" contribute ten cents apiece to pay the Secretary of State for recording their articles of incorporation, which is about all that seems to be necessary for starting a railway corporation in Kansas.

New Orleans, Natchez & Fort Scott.—It is reported that Chief Engineer WINGATE is at work on the survey of this road at Natchez, Miss.

ROCKY MOUNTAIN & PACIFIC.

Existing Roads.

Seattle, Lake Shore & Eastern.—The company has accepted the 10 mile section built by contractors Hunt & Patton, and tracklaying is in progress on the next ten mile section by Contractors Smith & Burns.——It is reported that Vice-President D. H. GILMAN has secured options on a majority of the company's capital stock; and is negotiating a deal for its transfer to the northern Pacific, Union Pacific, or St. Paul, Minneapolis & Manitoba companies, whichever will pay most heavily for the line. The deal will of course include the Seattle & West Coast, now in operation to Snohomish.

Oregon Pacific.—Track is now laid on this road, says the Albany *Herald*, to a point 7 miles beyond Mehama, a distance of 42 miles east of Albany; and regular trains are now run to Bates. More than 1,000 hands are at work on the grading above Tehama.

Union Pacific.—Two parties under the direction of G. W. SNOW and J. A. WEST have been at work on the surveys for the extension of the Utah Southern Railway from Milford, Utah, to Barstow, Cal. Besides the main line, which will be about 500 miles in length, a number of auxiliary lines have been surveyed, including several important branches. J. FEWSON SMITH, who has had charge of the surveys, reports that the country to be opened up possesses great mineral wealth and will eventually furnish an enormous local traffic. The maximum grade is 100 ft. per mile and the maximum curve is 6°. The cost of construction will generally be from $12,000 to $20,000 per mile.

The new Kansas line from Waldo to Colby has just been turned over to the operating department——It is reported that a party of Union Pacific engineers is at work on surveys for a branch in the Bitter Root valley in Montana, which will run to Missoula.——Rumors of the work of engineers on the proposed branch through Southern Oregon and Northern California continue to be received.

Vancouver, Klickitat & Yakima.—Rails are being delivered for this Washington Territory road, and work is progressing on both grading and tracklaying.

Denver & Rio Grande.—Surveys have been made for a tunnel through Tennessee Pass, between Denver and Red Cliff, Col.——The laying of the third rail on the line, which was stopped some months ago, has been resumed. ——The construction of the Sapinero & Lake City branch is greatly desired by the officers of the company; and as soon as it is possible to secure capital for the work at a reasonable price, it will be built.

Southern Pacific.—About 6 miles have been graded and tracklaying has begun on the coast line extension from Templeton. About 700 men are still employed on the Monterey reservoir, but as soon as that is completed they will be transferred to Templeton. The approaches to the tunnel will have a maximum grade of 116 ft. per mile.——It is reported that a party of surveyors on this line, while in camp about 4 miles east of San Luis Obispo, were poisoned by canned meats. The party were brought to the city and though seriously ill, all are expected to recover.

New Projects and Surveys.

Seattle & Northern.—Articles of incorporation have been filed by this company at Seattle, W. T., with a capital stock of $5,000,000. The lines to be built include a branch to Fedalgo, another to Spokane Falls, and a continuation of the main line from Skagit. The list of incorporators has on it the names of ELIJAH SMITH, President, W. H. HOLCOMB, General Manager, and other prominent officers of the Oregon Railway & Navigation Co.

Rio Grande & Utah.—A visit to Albuquerque, N. M., of J. W. CONLY, President of this company, with Director BEN. L. COOK of Chicago, and their consultation with V. D. SIMAR of Durango, Col., the locating engineer, have given rise to reports that this project is to be pushed during the winter.

Mexican Mineral.—This English corporation has been organized to build a railway about 13 miles in length, from Palmarejo to Lapote, in the State of Chihuahua, with a water conduit from Capon to Lapote.

Salt Lake & Eastern.—The Salt Lake City *Tribune* says:

Mr. Don McLean and Mrs. Jones, wife of Millard R. Jones of the Pacific Short Line (Salt Lake Valley & Eastern), left by last night's eastbound Owl for Rawlins, where they will meet Mr. Jones, who has been up looking over the great Carbon county coal measures which the Pacific Short Line will pass through. There are two distinct fields in western Wyoming, one about 12 miles long near Independence Rock and the soda lakes, and the other over 25 miles long at Twin Creeks, 100 miles from Ogden. The Independence Rock deposits are enormous enough, but the Twin Creeks' measures are simply boundless. There are 40 or 50 veins discovered, some of which are 100 feet wide, and Mr. McLean says the coal is first-class bituminous coal, and that it will coke equal to the best.

The line from Ogden into Twin Creeks country, 100 miles, will be reached by rail next fall when this coal will be laid down in Salt Lake City at $3 per ton! The easterly beds are 75 miles north of Rawlins, are 12 to 15 miles long and 34 veins have been uncovered there. The local Union Pacific coal department affects to make merry over Mr. MCLEAN'S proposal to lay coal down in Salt Lake at $3, and claims it can't be done; that it will cost to mine nearly $2 per ton, and that hauling cannot be done under $1 or $1.50. So they figure that Mr. MCLEAN'S statement is pure guff. The public will wait and see.

A report of Gov. W. WESTMADE to the Department of the Interior, dated Oct. 1, says that about 8 miles are completed on this road; 24 miles are under construction and 30 miles more are contemplated.

Red Deer Valley Ry. & Coal Co.—A charter is asked of the Canadian Parliament for a line from Cheadle station, Alberta, to the Red Deer coal fields, with a branch to Calgary.

Proposals Open.

Bridge.—Wardsville bridge. Stone pier and abutments, with wings; also iron superstructure with one 180 ft. span and one 50 ft. span. JAS. A. BELL, County Engineer, St. Thomas, Ont., Canada. December 6.

Sidewalks.—Flagging. JOHN P. ADAMS, Commissioner of City Works, Brooklyn, N. Y. December 7.

Pier Work.—Repairing Pier No. 2, East river, at foot of Whitehall St. THE DOCKS COMMISSIONERS, Pier A, North river, New York City. December 12.

Gate House.—Furnishing materials and constructing the gate-house at Central Park reservoir, laying the foundations, superstructure and substructure, constructing all chambers and appurtenances and doing all other work necessary to complete Section 17 of the New Aqueduct. JAS. C. DUANE, President, Aqueduct Commissioners, 280 Broadway, New York City. December 14.

Dams.—Building dams Nos. 1 and 2 on or near Bog Brook, in the town of South East, Putnam Co., N. Y., with adjacent tunnel, gate-houses and other appurtenances in connection with the East Branch reservoir, as called for in the approved forms of contract and specifications on file. JAS. C. DUANE, President, Aqueduct Commissioners, 280 Broadway, New York City. December 14.

Reservoir.—New reservoir at Ridgewood. Particulars on next page. JOHN P. ADAMS, Commissioner of City Works, Brooklyn, N. Y. December 19.

Water-Works.—Complete system. Plans and specifications prepared by NIER & MITCHELL, Kansas City, Mo. M. M. BANNISTER, City Clerk, Hays City, Kan. December 20.

Electric Lighting.—Furnishing a complete plant and lighting the city and city buildings for a term of 5 years. J. REYMERSHOFFER, City Hall, Galveston, Tex. January 5.

GOVERMENT WORK.

Pier Work.—Extending pier and making general repairs to piers at the following harbors on Lake Erie: Ashtabula harbor, O.; Fairport harbor, O.; Black River harbor, O. Preference will be given to materials and plant of domestic production or manufacture, conditions of quality and price (import duties included) being equal. Major T. COOPER OVERMAN, U. S. Engineer Office, Cleveland, O. December 8.

Rock.—About 150,000 tons, on barges. Major THOS. H. HANDBURY, U. S. Engineer Office, Portland, Ore. December 15.

Steel Wire.—About 21,000 lbs. of tinned steel wire of square cross-section. Brig. Gen. S. V. BENET, Chief of Ordnance, War Department, Washington, D. C. December 15.

Portland Cement.—Furnishing 3,000 bls. of best Portland cement at Rock Island arsenal. The cement required must possess the following qualities: Fineness—95 per cent. to pass through a sieve 50x50, equal to 2,500 meshes per sq. in. Weight—Struck weight of a bushel to be from 104 to 108 lbs. through a fall of 15 to 18 ins. Tensile strength—Neat (no sand) 1 day in air, 6 days in water; 350 to 375 lbs. per sq. in.; tensile strength, 1 cement and 2 sand, for same time as above, 100 lbs. per sq. in. (Not to set in less than 20 minutes). Parties desiring to bid will send as soon as possible, samples weighing not less than 25 lbs. net for test, free of charge, except transportation. Parties must state how much and how soon after April 1 1889, they can make first delivery, and how soon there after the other deliveries will be made. Parties will state brand of cement, and whether imported or domestic, and if imported, what the duties are per barrel. A preference will be given to articles of domestic production and manufacture, conditions of price and quality being equal. Col. T. G. BAYLOR, U. S. A., Rock Island, Ill. December 20.

Bridges, Buildings, Track, Etc.—For constructing a railway line in the Watervliet arsenal grounds; for building a wrought-iron bridge over the Erie canal, with masonry abutments; for preparing site, and excavating the foundations required for a shop building, and for building two sets of brick quarters. Bids will be received for all or part of the work. Col. J. M. WHITTEMORE, U. S. A., Watervliet Arsenal, West Troy, N. Y. December 24.

Sea-Wall.—Repairing granite sea-wall at the Naval Hospital, Norfolk, Va. J. MILLS BROWN, Surgeon General, Chief of Bureau of Medicine and Surgery, Navy Department Washington, D. C. December 27.

Stone.—Furnishing stone and placing it in the jetty at the entrance to Coos bay, Oregon. Amount to be expended on this work, $75,000. Capt. W. YOUNG, U. S. Engineer Office, Portland, Ore. January 15.

Bridges and Canals.

Canal.—At Broken Bow, Neb., the Board of Trade has decided to have a survey made for a canal from the Dismal river, near Dunning; the canal will pass through Anselmo, Merna, Broken Bow, Berwyn, Ansley, Mason to Ravenna.

Trestle.—The Elmira, Cortland & Northern R. R. Co. has awarded a contract to a Philadelphia firm for an iron trestle to replace the timber structure at Mott's Corners, near Ithaca, N. Y. The contract price is $40,000, and the work is to be completed by Jan. 1.

The Birmingham Bridge & Bolt Works, of Birmingham, Ala., have been purchased by H. M. Caldwell, who will enlarge the buildings and increase the plant.

Bridges at St. Paul, Minn.—The abutments for the upper town bridge are completed and work is in progress on the iron superstructure. Work is progressing on the pier foundations for the new section of the Wabasha St. bridge. The part to be immediately rebuilt is the section extending from the end of Wabasha St. to the island in the river. It will be necessary to rebuild the remainder at some future time, as the new part will be much wider than the West St. Paul end. All the old piers from the river bank to the island are to be removed, and this part will be rebuilt in 3 spans, instead of 4. By this plan a channel span of 280 ft. will be obtained. The present channel span is 240 ft. The width of the new part will be 56 ft., 36 ft. for roadway, with 10 ft. on each side for sidewalks. It will be a deck bridge. It is intended to have the new piers completed by Jan. 1, while the superstructure will be finished by June 1, 1889. The Marshal Ave. bridge across the Mississippi is approaching completion. The University Ave. bridge, over the Minnesota Transfer tracks, will be 60 ft. wide and 1,050 ft. long, including trestle approach. The State St. bridge of the Kansas City Ry. is in progress, and the Mississippi St. bridge over the St. Paul & Northern Pacific Ry. is completed. The railway bridge at Merriam Park will be completed this season, and the Dale St. bridge will be built early next year.

Bridge Notes.—*Boston, Mass.*—A bridge is to be built at Bolton St., South Boston, over the tracks of the New York & New England Railway, at an expense not exceeding $1,000.

Washington, Pa.—The commissioners of Washington county invite proposals for the purchase of $100,000 coupon bonds. This has been made necessary by the destruction of bridges in the July floods.

Charleston, W. Va.—The Charleston Toll Bridge Co. has been incorporated to build a bridge across the Kanawha river. Capital stock, $50,000, with power to increase to $250,000. B. L. WOOD, Jr., and J. V. HOAG, Jr., of Pittsburg, Pa., and R. S. CARR, S. M. SNYDER and S. NORR, of Charleston, are interested.

Memphis, Tenn.—The first caisson of the new bridge for the Kansas City & Memphis Ry. will be sunk this month, and the first pier is expected to be above water by January, after which work will be stopped till spring. The bridge will probably be completed in 2 years. The wagon and foot ways will be on a level with the railroad tracks, though the original idea was to have them overhead. ALFRED NOBLE is the Resident Engineer.

Savannah, Ga.—G. H. CRAFTS, of Atlanta, is building the belt line bridge over the Savannah, Florida & Western tracks at Habersham St. The contract calls for an iron structure 120 ft. long by 14 ft. wide, with iron supporting columns. It will be 20 ft. above the tracks, with trestle approaches.

Jacksonville, Fla.—The Jacksonville Bridge Co. has been incorporated by POWELL H. MASON, J.P. KELLY and J.R. PARROTT, to build bridges across the St. John's river. Capital stock, $100,000.

New Orleans, La.—A railway and highway bridge cross the Mississippi is projected. E. L. CORTHELL, C. E., is interested. It is proposed to have one pier in the center of the river, and the cantilever principle will be employed. The bridge will be made high enough to allow boats to pass beneath it at the highest stage of water.

Bay City, Mich.—The Milwaukee Bridge & Iron Works, of Milwaukee, Wis., have the contract for a bridge across the Saginaw river to West Bay City, at $102,964.

Minneapolis, Minn.—The new Franklin Ave. bridge is 1,000 ft. long. There is one through span of 300 ft., and 4 deck spans of 175 ft. each; the through span is 80 ft. above the river. The bridge was commenced about a year ago, and has cost about $140,000. A number of new bridge projects are being agitated.

La Crosse, Wis.—A bridge company has been formed, with a capital stock of $100,000, and if the city grants the aid asked for, the Mississippi will be bridged next year.

St. Louis, Mo.—The plans for the Merchants' bridge have been approved by the Secretary of War, and the work will now go forward.

Leavenworth, Kan.—A charter has been obtained for the construction of a pontoon bridge. The committee of the Board of Trade having the matter in charge appear to be confident that they will be successful in their efforts to have such a bridge built by next spring.

Ponca, Neb.—The Nebraska & Dakota Bridge Co. has been incorporated at Lincoln, Neb., with a capital stock of $2,250,000. The object of the company is to construct a bridge over the Missouri bridge near Ponca.

Spokane Falls, Wash. Ty.—A fifth bridge is to be built across the Spokane river within the city limits. It will be 1,240 ft. long, with two spans of 240 ft. and 160 ft. respectively, and 840 ft. of trestle approaches; it will be 36 ft. wide (with a 24 ft. roadway and two 6 ft. sidewalks) and 100 ft. above the water. It will be on the cantilever principle. The cost is estimated at $42,500.

Galveston, Tex.—The project for a bridge to the mainland is again being discussed. The cost is estimated at $1,500,000 to $2,000,000. Col. GRESHAM is interested.

Contracting.

The American Railway Equipment Co. has been reorganized, and has established new offices at 66 John St., New York.

The Railway Track Lifter Co. has been incorporated at Augusta, Me., by O. D. BAKER, and others. Capital stock, $150,000.

Scotch Drain Tile Wanted.—Jas. L. Pence & Co., of Covington, Ky., want the addresses of manufacturers of and dealers in Scotch drain tile.

Street Sprinkling.—At St. Louis, Mo., the Board of Public Improvements has awarded a contract for cleaning streets to the St. Louis Improved Street Sprinkling Co., at 78 cts. per 100 squares.

City Hall.—At San Antonio, Tex., the contract for building the new city hall has been let to E. Braden, at $11,897.

The Ripley Car Co. has been incorporated in Minnesota to build and lease railroad cars and to operate patents connected with such cars. Capital stock, $500,000.

The Chance Railway Frog Mfg. Co. will probably establish works at Woodstock, Ont., Canada.

Gauges.—The St. Paul Distillery Co., of St. Paul, Minn., has ordered 10 safety water columns from the Reliance Gauge Co., of Cleveland, O.

Electric Railway.—*Wichita, Kan.*—The Riverside & Suburban Ry. was opened on Nov. 13. The length of road in operation is 2½ miles, and work is in progress on the remaining 3½ miles. The line is operated on the Thomson Houston system. President, J. O. DAVIDSON; Superintendent, F. G. FITCH; Manager, F. W. SWEET.

Brick Yards.—The Calumet & Chicago Canal & Dock Co. will establish extensive brick yards at the north end of Lake Calumet. The clay of the bottom of the lake is of good quality for brick making, and five slips 110 ft. wide, 1,750 to 2,500 ft. long and 14 to 16 ft. deep, will be constructed. During the winter, ice will be cut in these slips.

Water-Works.—*Santa Ana, Cal.*—The following proposals for the construction of the city water-works have been received by E. TEDFORD, City Clerk: W. R. Coats, Santa Ana, $20,000; Eclipse Wind Engine Co., San Francisco, $22,742; G. L. Dean, Santa Ana, $22,778, Baker Iron Works, Los Angeles, $23,344; M. Macdonald, San Bernardino, $34,000. The contract was awarded Nov. 14 to W. R. Coats. The city has sold $25,000 bonds.

Ridgewood Reservoir.—City Commissioner ADAMS, Brooklyn, N. Y., is advertising for proposals for the construction of the new distributing reservoir at Ridgewood. It will be the same size as the present reservoir, with a capacity of 16,000,000 galls. The city has appropriated $450,000 for the work, but the engineers' estimates are below this amount. The work will be done under the supervision of the city engineer. The contractor will also build a gate house and sluiceway. The reservoir is to be lined with puddle and is to be surrounded with a sloping embankment 24 ft. wide at the top. The work is to be completed within 600 working days, but no mason work or puddling is to be done between Dec. 1 and March 16, or when it is freezing.

The Edge Moor Bridge Works is the name of the company that will take over the business of the Edge Moor Iron Co., of Wilmington, Del., for the manufacture of bridges, roofs, viaducts, turntables and structural work; the iron company will continue in the other branches of its business. President, HENRY G. MORSE; Vice President, WM. SELLERS; Secretary, WM. F. SELLERS; Treasurer, W. H. CONNELL; Purchasing Agent, F. W. HERSLER.

Metal Markets.—*Structural Iron.*—Prices are about as follows: in Philadelphia, 2.05c. @ 2.10c. for bridge plate; 2c. @ 2.10 c. for angles; 2.6c. @ 2.7c. for tees, and 3.3c. for beams and channels, iron or steel. Store prices are as follows in Chicago: angles, 2.35c. @ 2.50c.; tees, 2.60c. @ 2.70c., beams, 3.80c. Mill orders are taken at the following rates, f. o. b. Chicago: Angles, 2.15c. @ 2.20c.; universal plates, 2.25c. @ 2.30c.; tees, 2.55c. @ 2.65c.; beams and channels, 3.40c. New York prices are: sheared plates, 2c. @ 2.1c.; universal mill plates, 2.1c. @ 2.2c.; angles, 2.1c. @ 2.15c.; tees, 2.5c. @ 2.6c., channels and beams, 3.3c.

Steel Rails.—New York, $27 @ $28. Pittsburg, $28 @ $28.50.

Railway Track Supplies.—Pittsburg, Pa.; spikes, $2.20, 30 days, delivered; splice bars, 1.85c. @ 1.90c.; track bolts, 2.85c. with square, and 2.95c with hexagon nuts. New York; spikes, $2.20 @ $2.25, delivered.

Old Material.—Pittsburg, Pa., No. 1 wrought scrap, $21, net ton; wrought turnings, $13.50 @ $14; car axles, $25.50 @ $26.50; cast scrap, $15.50 @ $16, gross ton; cast borings, $12 @ $13; old car wheels, $20. Short pieces of steel rails at $18.75 gross, and long length ditto at $20.50.

Plate and Tank Iron.—Philadelphia, Pa. Quotations about as follows: ordinary plate and tank iron, 2.05c. @ 2.15c.; shell, 2.4c. @ 2.5c.; flange, 3.5c.; fire-box, 4c.; steel plates, tank and ship plate, 2.25c. @ 2.3c.; shell, 2.7c.; flange, 3c. @ 3¼c.; fire-box, 3¼c. @ 4¼c.—(Compiled from *Iron Age*, Nov. 29).

Electric Lighting.—*Galt, Ont.*—The only bid received by A. MCAUSLAN, Chairman of the Fire & Water Committee, was from R. Scott; 32 lights till midnight, 22 cts.; 10 till sunrise, 50 cts.; any additional all night, 40 cts.

Government Work.—*Revetment.*—The following proposal for revetting the banks of Wappoo Cut, was opened Nov. 21 by Capt. F. V. ABBOT, U. S. Engineer Office, Charleston, S. C.: Anson M. Bangs, Fayetteville, N. Y.; 700 cu. yds. of stone in place, $4.22; 30 trees to be removed, $1 each; 1,000 cu. yds. earth in place, 29 cts.

Pier.—The following proposals for the construction of a pier in front of Fort Brady at St. Mary's Falls canal, Michigan, were opened Nov. 19 by Col. O. M. POE, U. S. Engineer Office, Detroit, Mich.: Luther E. Allen, Charlevoix, Mich.; white pine timber, 24 cts. per cu. ft.; hemlock timber 13 1-5 cts.; piles, $3 each; iron and bolts, 3 cts. per lb.; driving piles, $4 each; framing, bolting and placing pine and hemlock timber, 7 cts. per cu. ft.; stone filling, 48 cts. per cu. yd.; total, $49,042. Powell & Mitchell, Marquette, Mich.; timber, 21½ and 16½ cts.; piles and driving, $3 and $2.25; bolts, 3 cts.; framing, 6 and 6½ cts.; stone, 70 cts.; total, $54,157.50. Chauncey E. Mitchell, Ludington, Mich.; timber, 23 and 16 cts.; piles and driving, $5 and $3; bolts, 3½ cts.; paving, 6½ and 7 cts.; stone, 60 cts.; total, $54,597.50. Wm. S. Smith, Sault Ste. Marie, Mich.; timber, 21 3-5 and 14 1-10 cts.; piles and driving, $4 and $3; bolts, 2 8-10 cts.; framing, 8½ cts.; stone, 60 cts.; total, $56,157. Wilson & Monroe, Sault Ste. Marie, Mich.; timber, 27½ and 15 cts.; piles and driving, $5.50 and $4.90; bolts, 3¾ cts.; framing, 3½ and 4½ cts.; stone, 95 cts.; total, $59,113.50. Robert D. Perry, Sault Ste. Marie, Mich.; timber, 25 and 16 cts.; piles and driving, $4 and $3.25; bolts, 2 9-10 cts.; framing 6½ and 7½ cts.; stone, 90 cts. total, $61,388.50. McKeone & Drummond, Sault Ste. Marie, Mich.; timber, 31 and 17½ cts.; piles and driving, $2.40 and $3; bolts, 3 cts.; framing 6½ and 7½ cts.; stone, 80 cts.; total, $62,351. John Drew & Co., Sault Ste. Marie Mich.; timber 22 and 14½ cts.; piles and driving, $4.40 and $4.50; bolts, 3 cts.; framing, 10 and 11 cts.; stone, 75 cts.; total, $62,800. Hoag & Petitdidier, Pittsburg, Pa., timber, 23 and 16 cts.; piles and driving, $5 and $3; bolts, 3 cts.; framing, 8 cts.; stone, 84 cts.; total, $63,740. James B. Donnelly, Oswego, N. Y.; timber, 24 and 14 cts.; piles, $6 and $10; bolts, 4 cts.; framing, 8 cts.; stone, 85 cts.; total, $65,060. Carkin, Stickney & Cram, East Saginaw, Mich.; timber; 30 and 20 cts.; piles and driving, $4.50 and $4; bolts, 7 cts.; framing, 5½ and 6½ cts.; stone, $1.50; total, $82,830. The quantities are as follows: 34,000 cu. ft. of white pine timber, 96,000 cu. ft. of hemlock timber, 300 piles, 89,000 lbs. of iron and bolts, 49,000 cu. ft. white pine framing, 12,600 cu. ft. hemlock framing, 22,000 cu. yds. stone

Sewers.—*Amsterdam, N. Y.*—Contracts have been awarded as follows for the construction of sewers in District No. 8: WM. B. LANDRETH is Consulting Engineer, and F. S. CRANE is Assistant Engineer.—*Material*; Carpenter & Woodruff, Troy, N. Y.; 28 ft. of 4-in. sewer pipe, 8 cts. per ft.; 250 ft. of 6-in., 12 cts.; 7,248 ft. of 8-in., 13½ cts.; 726 ft. of 10-in., 20 cts.; 354 ft. of 15-in., 37½ cts.; 1,864 ft. of 20-in., 90 cts.; 546 8-in. Y branches, 61 cts.; 54 10-in., 88 cts.; 25 15-in., $1.69; 68 20-in., $4.05; 18 tees, 61 cts.; 14 bends, 26 cts.; 2,518 ft. of 3-in., drain tile, $17.50 per M. 5,122 ft. of 4-in., $33; 1,814 ft. of 6-in., $70; 50 bls. Portland cement, $2.80; 300 bls. Rosendale cement, $1.20; 70,000 brick, $7.25 per M.; 4,727 ft. lumber, $14 per M.; 800 lbs. jute, 7½ cts.; 30,200 lbs. iron pipe, $32 per ton; 342 lbs. lead, 4½ cts.; total, $6,148.14. Iron Castings: Perkins & Schmidt, Amsterdam, N. Y.; 19,500 lbs., 2½ cts., $489.75.—*Labor*; Timothy Sullivan & Co., Syracuse, N. Y.; excavation, 2,178 ft. to 6 ft. deep, 22 cts.; 4,415 ft. of 6 to 7 ft. deep, 25 cts.; 2,170 ft. of 7 to 8 ft., 30 cts.; 1,100 ft. of 8 to 9 ft., 32 cts.; 416 ft. of 9 to 10 ft., 40 cts.; 477 ft. of 10 to 11 ft., 60 cts.; 165 ft. of 11 to 12 ft., 65 cts.; 25 ft. of 12 to 13 ft., 75 cts.; 325 ft. of 13 to 14 ft., 80 cts.; 71 ft. of 14 to 15 ft., 90 cts.; 75 ft. of 15 to 16 ft. $1; 253 ft. of 16 to 18 ft., $1.35; 188 ft. of 18 to 20 ft., $1.60; 175 ft. of 20 to 22 ft., $1.80; 50 ft. of 22 to 24 ft., $2; 100 yds. rock, $2.50; laying 250 ft. of 6-in. pipe, 2 cts.; 8,340 ft. of 8-in. and 834 ft. of 10-in., 3 cts.; 404 ft. of 15-in. and 2,000 ft. of 20-in., 4 cts.; 9,454 ft. of drain tile, 1 ct.; laying 120 ft. of 8-in. iron pipe, 10 cts.; 135 ft. of 20-in., $1; 100 ft. (outlet) of 10-in., $2; 27 manholes, $14; 14 flush tanks, $14; 18 inspection holes, $3; total, $6,316.68.

Dredging.—The following proposals were opened Nov. 21 by Capt. GEO. MCC. DERBY, U. S. Engineer Office, New York City: In Buttermilk channel, New York harbor: Atlas & Hercules Dredging Co., New York, 15 cts.; per cu yd., scow measure; Henry DuBois' Sons, New York, 27½ cts.; W. H. Beard, Brooklyn, N. Y., 29 cts.; Morris & Cummings Dredging Co., New York, 29 cts.; P. Sanford Ross, Jersey City, N. J., 31¾ cts.; Thomas Potter, Jersey City, N. J., 34 cts.—In Gowanus bay, New York; Atlas & Hercules Dredging Co., 15 cts.; W. H. Beard, 29⅞ cts.; Elijah Brainard, New York, 31 cts.; Hy. DuBois' Sons, 32 cts.; P. Sanford Ross, 34½ cts.; Morris & Cummings, 34¼ cts.; Thomas Potter, 39 cts.—In Raritan bay, New Jersey; Thomas Potter, 23¾ cts.; P. Sanford Ross, 25 cts.; Hy. Du Bois' Sons, 29 cts.; W. H. Beard, 29½ cts.; Morris & Cummings, (price not stated in bid).—Removing broken rock from Flood Rock at Hell Gate, New York; Morris & Cummings Dredging Co., New York, $3.50 per ton of 2,240 lbs. These bids were considered too high, with the exception of that of the Atlas & Hercules Dredging Co.

Electricity.—WM. SEAFERT & Co., of Chicago, Ill., have issued a little pamphlet descriptive of the Seafert system of generating, transmitting and utilizing electrical energy, for lighting, street railways, power, etc.

The Monroe Sidewalk & Sewer Pipe Co. has been incorporated at Milwaukee, Wis., by CHAPIN MOORE, J. C. WAMBOLD, H. A. WAMBOLD and HENRY ULLRICH. Capital stock, $50,000.

The Northern Construction Co. has been incorporated at Chicago, Ill., by E. B. FOLMAN, CHAS. A. GRANT and A. L. HOWARD. Capital stock, $1,000,000.

The Philadelphia Bridge Co. will establish new works at Roanoke, Va., on 8¼ acres of land granted by the Roanoke Land & Improvement Co.

The Southern California Water & Sewer Pipe Co. is the new name of the Los Angeles Water & Sewer Pipe Co. The capital stock has been increased to $100,000.

The Rodger Ballast Car Co. has been organized at Chicago, Ill., by THOMAS RODGER, JOSEPH E. WOODS and WM. S. BREWSTER.

Filter.—The Hyatt Pure Water Co., of New York, has an order from the Geo. R. Dickinson Paper Co., of Holyoke, Mass., for a filter plant similar to those in use at other paper mills.

Gaskets.—The corrugated copper gaskets made by the U. S. Mineral Wool Co., of New York, will be used on the flange joints of the new Edison Electric Light Co.'s plants in New York. They are also being used on the cylinder flanges of the express steamers of the Bremen S. S. Co.

The Corpus Christi Deep Water Harbor & Channel Co. has been incorporated at Corpus Christi, Tex., by E. H. ROPES, E. B. CHANDLER and J. B. MITCHELL. Capital stock, $3,000,000. This is another enterprise for establishing the much needed deep water port on the Gulf coast.

Brick Sidewalks and Gas Apparatus.—The following contracts have been awarded by Capt. GEO. H. COOK, U. S. A., Davids Id., N. Y.: John Sheehan, New Rochelle, N. Y., brick sidewalks, $1 per lin. ft.; Geo. H. Denney, lighting apparatus for barracks, $1,123.

Asphalt Paving.—At Rochester, N. Y., it has been decided to have asphalt paving on Lake Ave., the competition to be open to the Vulcanite, Warren-Scharf and Bolze companies.

Plank Road.—The following is from the specifications in use at Houston, Tex. "The superstructure shall be as follows: Mud sill 4x8 ins., not less than 16 ft. on the flat: the outside sills 6 ins. from ends of plank intermediate, spaced 5 ins. from centers. The covering to consist of 3x8-in. plank, with space blocks 3x6¾ ins. placed over each mud sill in every space; said planking to be securely spiked to every sleeper with 60d steel spikes, and pressed or driven hard against space blocks in spiking. The material used in the above work shall be long leaf heart pine, free from sap, bad knots and wind shakes, and perfectly out of wind."

Viaduct.—*South Omaha, Neb.*—The following proposals for the construction and furnishing of all necessary material for a viaduct over the B & M. and U. P. railway tracks, on L St. were opened by E. B. TOWL, City Engineer, on Nov. 15: New Jersey Iron Co., $16,000 for 1,135 ft. of trestle; $25,500 for 364 ft. of steel trusses including foundations. Sioux City Construction Co., $14,387 for trestle, $29,379 for iron trusses. Kansas City Bridge Co., $14,900 for trestle, $31,000 for steel trusses, $28,790 for iron trusses. C. A. Hubbard, Omaha, $39,700 for steel and iron trusses and trestle. Minneapolis Bridge Co., $43,500 for iron trusses and trestle, $38,500 combination, complete. Wrought Iron Bridge Co., Canton, O., $45,000 for iron trusses, with trestle, complete. J. H. Sparks, St. Joseph, Mo., $43,000 for steel trusses, with trestle complete. Missouri Valley Bridge Co., $14,750 for trestle, $28,889 for iron trusses, with foundation. Keystone Bridge Co., $37,495.60 for steel and iron trusses, with trestle. Phœnix Bridge Co., $15,000 for trestle; $30,000 for iron trusses, with foundations. St. Louis Bridge & Iron Co., $42,750 for steel trusses, with trestle. Templeton & Morrow, $38,838 for iron trusses, with trestle. King Iron Bridge & Mfg. Co., $15,000 for trestle, $26,350 for steel trusses, with foundations. Lane Bridge & Iron Works, $14,444 for trestle, $28,888 for steel and iron trusses, with foundations. Milwaukee Bridge & Iron Works, $13,999 for trestle, $27,599 for steel and iron trusses, with foundations. The contract was let to the Milwaukee Bridge & Iron Works at $41,598 for work complete. The viaduct will consist of about 1,135 ft. of pile trestle; one 96 ft. through truss, and two 134 ft. through trusses. Total length of viaduct, about 1,495 ft.; total width, 32 ft. roadway, and two 5-ft. sidewalks. Live load, 100 lbs. per sq. ft.; dead load on trestle, 50 lbs. per sq. ft. Bonds to the amount of $43,000 have been voted for the construction of the structure.

Chicago.—The following proposals for the construction of a 3-span viaduct at 35th St., were opened Nov. 21 by GEO. B. SWIFT, Commissioner of Public Works: A. Gottleib & Co., Chicago, $63,344; Chicago Forge & Bolt Co., $63,850; Riter & Conley, Pittsburg, Pa., $65,341; Detroit Bridge & Iron Works, $68,400; Pittsburg Bridge Co., $69,935; Keystone Bridge Co., Pittsburg, Pa., $73,500. The contract was awarded to A. Gottleib & Co.

WATER.

Montreal, Canada.—A syndicate has purchased Isle au Herron, in Lachine Rapids, for the purpose of developing the water power and furnishing electric power and lighting for the city. The building of necessary dams, bridges, etc., will be commenced immediately. The improvements will cost about $500,000.

Wilkesbarre, Pa.—One of the most serious "cave-ins" reported for a long time, occurred Nov. 23 at Parson's Station, between the Mineral Spring and Laurel Run collieries. Both the 16-in. mains of the Wilkesbarre Water Co. which convey water from the Laurel Run reservoir to the city were broken, and the water from the reservoir flowed into the mines, the city's water being cut off. The cave-in extended over an acre. The mine machinery is badly damaged. "Robbing" the coal pillars which supported the roof of the mines caused the accident. No lives were lost, but the walls of several houses were cracked.

Bayonne, N. J.—The City Council has proposed to make a contract for a water supply with the Montclair Water Co. According to the proposition, the city will contract for a supply of pure water for a term of 25 years to be delivered at Avenue D, on the Morris canal. The water may come from the Passaic river and its tributaries above Paterson. Bayonne will agree to take not less than the amount of water she now uses. In regard to the price, the draft stipulates an amount not exceeding $90 per 1,000,000 galls. up to 10,000,000 galls. a day. The Council does not expect to pay that figure unless the Montclair Water Co. arranges to bring down the water for Bayonne alone, which the company is said to be willing to do. But if Jersey City, or other places, conclude to make contracts with the same company, Bayonne expects to pay much less than $90 per 1,000,000 galls. A survey has been made to find out how to lay pipes to Bayonne without going through Jersey City, and the cost of that work.

Bangor, Me.—F. H. WHIPPLE, of Detroit, Mich., has been making investigations preliminary to preparing an estimate of the cost of the electric light plant proposed to be established by the city. The plant will be located in the water-works building at the dam, and there is ample power for driving it. At the water-works there are 3 wheels of 125 H. P. each, which are not now in use, and it only requires about 120 H. P. to run 120 arc lights. Mast arms may be used. The following is a rough estimate of the cost per year of maintaining a 120 light plant, the lights to run all night or 3,700 hours during the year, and every night, as follows:

135,000 carbons	$1,400
Trimming by line men	1,248
Interest on investment, 5 per cent.	600
Depreciation	1,200
Oil and waste	52
Miscellaneous	500
Total	$5,000

St. John and Portland, N. B.—The Commissioners of Sewerage and Water Supply have issued their report for 1887. Nothing special had taken place during the year, and the work in each department was mainly supervisory. There were laid 2,110 ft. of main and 2,145 ft. of service pipe, and there are now 71½ miles of pipe, 4,985 stop-cocks, 37 hydrants (14 in St. John and 23 in Portland), and 288 fire plugs (111 in Portland and 177 in St. John). On the sewerage system a length of 1,531 ft. was added to the main drainage of the city, and 19 gullies placed for the reception of surface water and house drains entered into the public sewers. The whole length of sewers in use in St. John (East), at the time of the report, was 104,768 ft., about 78 per cent. being built in accordance with the general plan adopted by the Board in 1886, and 22 per cent. being old wooden sewers, of innumerable forms and grades, all more or less ready for renewal. GILBERT MURDOCH, C. E., is Superintendent of the Sewerage and Water-Works.

Norfolk, Va.—The Board of Water Commissioners has presented its report for the year ending June 30, 1888. The present daily pumpage is 3,000,000 galls., but it is expected that extensions of the pipe system will result in increasing the pumpage to 4,000,000 galls. per day, which is the estimated supply from all sources in time of drought. For increasing the water supply a sum of $8,500 has been appropriated for a system of gang wells, with a filter plant. The pumping plant comprises the following; at Moores Bridge, Worthington high pressure pump of 1,000,000 galls., daily capacity, Worthington compound pump of 2,000,000 galls., Worthington high pressure compound pump of 2,000,000 galls., Gaskill compound condensing duplex pump of 5,000,000 galls., and Ingersoll air compressor for aerating 3,000,000 galls. daily; at Lake Lawson, Worthington high pressure pump of 2,000,000 galls. daily capacity, Dean high pressure pump of 2,000,000 galls., independent condensing apparatus for the two engines; at Bradford, Gaskill high pressure pump of 2,000,000 galls. Increased pumping capacity is recommended. There is an aeration plant with a daily capacity of 3,000,000 galls., put in by the National Water Purifying Co., of New York, but a system of mechanical filtration is recommended. There are 109.535 miles 1½-in. to 24-in. pipe, 126 hydrants and 272 gates. R. Y. ZACHARY is Superintendent of Water-Works.

Denver, Col.—A company has been organized to construct a large reservoir, and has secured the Marston lakes and other supplies which will afford sufficient water for the domestic, irrigation and fire supply of a city of 300,000 population. Water will be taken from several creeks to supply the reservoirs. The main reservoir will be at the Marston lakes, about 1½ mile long and 1 mile wide, with a depth of 75 ft. The elevation is 410 ft. higher than the union depot. A number of pipe lines will be laid and new ditches built. J. P. MARSTON, THEODORE HERR and H. C. DONNELL are interested.

Boston Mass.—The Water Board has asked for an appropriation of $300,000 to be added to the loans for the extension of mains and to be expended during the next calendar year. The Board states that, owing to the recent addition of a large portion of the business section of the city to the high service system, the pressure upon the pipes of that system has been very much reduced, to the great inconvenience of numerous water takers. To obviate this difficulty the city engineer recommends the laying of a new 20-in. main from Parker hill reservoir to the Common, and also the improvement of the high service in the Roxbury and Dorchester districts by the laying of additional mains. The cost of these improvements the city engineer estimates at $80,360, and this sum is included in the amount asked for, the balance of the loan being needed for the ordinary extensions of the service. Speedy action is asked for, as the Board is anxious to make contracts for pipe as soon as possible, experience having demonstrated that such contracts can be made at this season upon terms favorable to the city.

Electric Light.—The Thomson-Houston Electric Co. is putting in new plants as follows: Chattanooga, Tenn., 200 arc lights; Findlay, O., 185; Wood, Brown & Co., Philadelphia, 60: Young, Smith & Co., Philadelphia, 60; Ensley, Ala., 35. Also increasing plants as follows: Johnstown, N. Y., 50 arc lights; Salem, Mass., 25; Columbus, O., 100; Toledo, O., 100; Mobile, Ala., 85; Nashua, N. H., 45; Oneida, N. Y., 35; Waltham, Mass., 50; Cambridge, Mass., 45; Columbia, S. C., 30; Atlanta, Ga., 50; Hyde Park, Mass., 50; Stamford, Conn., 30; Rome, N. Y., 50; Somerville, Mass., 50; Worcester, Mass., 35 (and 800 incandescent); East River Co., New York, 100 (and 1,000 incandescent); Buffalo, N. Y., 800 incandescent; Waterville, Conn., 500 incandescent; Malden, Mass., 500 incandescent.

Buffalo, N. Y.—The Water Commissioners were authorized last May to prepare plans and specifications for a reservoir on the Dodge farm. The engineering force of the Water Department has been steadily employed upon the trial borings, and other preliminary work since that time, and the plans are now completed. Engineer PHILIP SEITZE has had personal charge of the work during the summer. The proposed reservoir will have a capacity of 90,000,000 galls. and it is estimated will cost $350,000. The work will occupy 3 years. WM. J. MCALPINE, of New York, has been engaged to examine and report upon the plans. If he indorses the views of the local engineer, the specifications and accompanying recommendations will be sent to the Council for its approval. If the Aldermen and the Mayor are favorable to the project the work will be let as soon as possible. The reservoir is nominally to supply the residents of East Buffalo with the water which the present mains cannot provide, but in reality the reservoir will be capable of supplying the whole of the city, save one or two of the highest portions, with all the water needed. The highest parts of the city will require to be furnished with water by direct pumping as at present.

Irrigation in Wyoming.—Territorial Engineer MEAD has made a report to Gov. MOONLIGHT, of Wyoming Territory. A distinctive feature of Wyoming's irrigation is that it outstrips other States and Territories of the arid region in the number of its streams available for irrigation. The valleys bordering most streams are narrow, ranging in width from ½ to 5 miles. The uplands between these valleys are too high to be watered and must remain for grazing land. In the counties of Laramie and Albany are found the largest and best constructed ditches. The irrigation works of these two counties also most nearly utilize the waters of their streams, on a majority of which the aggregate capacity of the ditches exceeds the average discharge of the streams during the irrigating season, and the further extension of the irrigating territory can only be accomplished through the construction of reservoirs to store up the surplus water of the spring floods. In most parts of the territory there are favorable locations for the construction of irrigation works, and the report states that the development of many parts is limited by the lack of railway facilities. The following are approximate totals: number of ditches, 1,718; length, 3,208 miles; capacity, 21,207 cu. ft. per sec.; acreage, 1,260,143. The subject of comprehensive irrigation legislation will be brought before the next legislative assembly. In connection with the territorial engineer's office, a territorial weather service has been established, the signal service bureau furnishing the instruments. Five stations have been established in as many agricultural districts.

Water-Works in South America.—English capitalists are now being invited to invest in water-works for some of the principal cities of South America, and such works may possibly become as favorite a field for investors as railways are now.

Artesian Wells.—*Savannah, Ga.*—Wells are to be sunk by the Savannah Investment Co.

Alexandria, La.—The well in the city square is down to a depth of 585 ft.

Waco, Tex.—The second artesian well put down by JAMES I. MOORE is a success and is yielding a good flow of water

Galveston, Tex.—The Board of Water Commissioners has agreed to pay the artesian well contractors the first installment of $15,000 as soon as the present water supply can be measured and the fact ascertained that there is at present a daily flow of 750,000 galls. Well No. 7 is finished.

Denver, Col.—The artesian well put down by MILO A. SMITH on East Capitol hill is 715 ft. deep and furnishes a plentiful supply of water.

Los Angeles, Cal.—The committee appointed to investigate different methods of sewage disposal, has recommended that the proposition of the Pacific Sewage Co. for establishing a system of deodorizing and utilization similar to that in use at Atlantic City, N. J., be accepted. By this system the water can be used for irrigation, and the sludge is used as a fertilizer.

Water-Works.—*Maine.*—Boothbay. A petition for a division of the town will be presented to the next legislature, the residents at the Harbor and of the country portion of the town not being able to agree. The people of the Harbor want a system of water-works, and repeated meetings of the town have been called to effect their introduction, but the project has been each time voted down. The Harbor citizens have now resolved to ask for a division, and R. M. WHITE, C. E., is running a line which will be made the new town line if the petition is granted.

New York.—Sandy Hill. The works are approaching completion. CHARLES A. DEVINE has been elected Secretary of the water company.——Castile. The reservoir is being built.——Yorkshire Centre. Water-works have been contemplated but it is doubtful if any action is taken this winter, as the interest in the matter has died out, and nothing short of a fire will start it again. D. E. ARNOLD is Town Clerk.——Sidney. There is some talk of putting in water-works.

New Jersey.—Jersey City. The water supply question is still the subject of much discussion, but nothing definite has been settled. The Board of Trade is opposed to a contract with a private corporation.

Virginia.—Roanoke. The Roanoke Water-Works Co. is considering a proposition to purchase another large spring a few miles from the city, so as to insure an adequate supply of water when the demand exceeds the capacity of the present reservoir.

Tennessee.—Chattanooga. The Spring Lake Water Co., of which ROBERT MORRISON is President, has applied for permission to lay its mains.

Kentucky.—Georgetown. Water-works are projected. Address JOHN A. BELL.——Jeffersonville. The water-works are nearly ready for the test. GEO. C. STEVENS is Resident Engineer.

Alabama.—Anniston. The Anniston Water Supply Co. has been incorporated.——Calera. A water-works company is to be organized; the supply will be taken from an artesian well. J. R. ADAMS is interested. The cost is estimated at $50,000.——Uniontown. Water-works to cost $4,000 or $5,000 are to be built, the supply is to be secured from a well. M. L. ERNST is Chairman of the Water Board. A bill has been introduced in the legislature to authorize the issuing of bonds for $5,000.

Indiana.—Huntingburg. H. ROTHERET is the president of a company organized to build water-works.——Portland. Water-works are needed. Mayor, THEO. BAILEY; Clerk, J. M. BEILMAN.

Illinois.—Springfield. The connection between the filter gallery and the well has been completed, and the pumps set.——Ipava. There are no water-works, but a woollen factory has a supply of water from an artesian well. Mayor, WM. BABCOCK.——Monticello. There are no water-works, and no immediate prospects of any being built.

Colorado.—Greeley. The vote on the issue of bonds for water-works was carried by a majority of 54. The water will be taken from a reservoir and the works will cost about $65,000.

Nebraska.—O'Neil. Nothing will be done with the water-works project before next spring. A. M. MORRIS is Chairman of the Board of Trustees.

Washington Territory.—Seattle. The water question will be voted on at the general election in July 1889. In the meantime a franchise has been refused the Cedar Valley Water Co.——Spokane Falls. Proposals for the purchase of $70,000 water-works bonds were opened Nov. 25.

Nevada.—Tuscarora. The pipe for the water-works has been delivered and the town will soon have a water supply.

Utah.—Salt Lake City. The Superintendent of Water-Works strongly favors building a reservoir on the east side to supply East Salt Lake, getting its supply of water by night from Parley's cañon canal, which can feed the ditches by day. He would have the reservoir on the same level with the lower water-works system, so that both can be used separately or together, as the occasion demands. It would not do to connect the upper and lower systems, as that would increase the pressure in some parts of the city to nearly 200 lbs. per sq. in., whereas the safety limit is 150 lbs. With the reservoir to supply the east side, and the lower works to supply the city below Brigham St., the upper system could be used to feed Wards 18, 20 and 21. This would give a uniform pressure of about 86 to 90 lbs. at all the hydrants.

Texas.—Llano. The water supply system is owned by W. W. Knowles & Son, and has been in operation 2 years; the supply is taken from the Llano river and pumped to a tank with a capacity of 17,000 galls. by a plunger pump of 25,000 galls. daily capacity which is run by an attachment to a water mill. There are 2 miles of pipe, 40 taps and 1 meter. Average daily consumption, 9,000 galls. Ordinary pressure, 40 lbs. Cost of works, $2,500; no debt. Annual operating expenses, $10. Annual revenue, $350 from consumers, $18 from city. The town is very scattered and it cannot afford to pipe water to residences for the amount that would be consumed; but the town is expected to grow. Present population, 1,000.

Canada.—Toronto. The city will expend $90,000 on the improvement of its water-works.

Special Reports of Water-Works Construction.

THE ENGINEERING NEWS MANUAL OF AMERICAN WATER-WORKS is now being compiled, and will be *indispensable* to every manufacturer, engineer and contractor in any way interested in Water-Works construction and maintenance, and will be of great value to Water-Works superintendents and projectors of new works.

Superintendents of water-works and water companies will wish to see correct and complete data concerning their Works in our MANUAL, and to ensure this they should send in reports *at once* upon the blanks which we have already sent to every Water-Works office in the United States and Canada. Many have delayed their report, and if the blanks we intended for them have been lost in the mail, or mislaid, we will send more upon request.

We *must* have a report from every public water supply system in North America, so those who reply to our inquiries at once will save a second inquiry. We also wish to know of *every* new Water-Works plant in process of construction, and of *every* new project in this line. We will send to any one desiring them, blanks upon which reports can be made.

Further details of the MANUAL will be advertised later. We abstract from our special reports for the MANUAL the following items of current interest:

SHELBURNE, Ont., Nov. 23, 1888.

EDITOR ENGINEERING NEWS:—A by-law has been carried here for $12,000 to build water-works, but nothing has yet been done toward beginning the work. I believe a contract is about to be completed for sinking a deep well, as a test, as there is no other supply available. F.G. DUNBAR, Village Clerk, will give further information. P. M.

ANTWERP, N. Y., Nov. 20, 1888.

EDITOR ENGINEERING NEWS:—A year ago an attempt to vote an appropriation to put in water-works was defeated by about 15 majority. There was talk of trying it again, but we have not done so. Address W. J. JOHNSON, Clerk of the Board of Trustees, for further information. M. L. WILLARD.

COXSACKIE, N. Y., Nov. 23, 1888.

EDITOR ENGINEERING NEWS:—Water-works have been projected. I refer you to R. F. VAN BERGEN for information.

FAIRPORT, N. Y., Nov. 22, 1888.

EDITOR ENGINEERING NEWS.—A franchise was granted to a water-works company last summer but no move has been made, as yet, towards building the works.
E. L. HODSKIN, *Prest. of Village.*

LURAY, Va., Nov. 23, 1888.

EDITOR ENGINEERING NEWS:—We have a large windmill supplying some families with water. They are much pleased with it. I believe if proper attention were given to this matter, water-works could be established here. Address, H. V. HENDSEN, or P. M.

MOUNDSVILLE, Va., Nov. 24, 1888.

EDITOR ENGINEERING NEWS:—For some time an attempt has been made to build water-works here. For prompt and complete information address G. S. MCFADDEN. P. M.

ROCKMART, Ga., Nov. 22, 1888.

EDITOR ENGINEERING NEWS:—We expect water-works when the company is fully organized, but cannot give full particulars now. L. J. MORRIS.

WASHINGTON, Ga., Nov. 17, 1888.

EDITOR ENGINEERING NEWS:—Application has been made to the present legislature for authority to issue bonds for complete system of water-works, and I think we will be authorized to do so before 90 days. The population of our village is 3,000, and it is proposed to supply it by pumping from springs to a stand-pipe at an estimated cost of $10,000. Among others, W. A. BENSON, or T. C. HOGUE can give information.
T. BURWELL GREEN.

MILAN, O., Nov. 21, 1888.

EDITOR ENGINEERING NEWS:—Water-works were begun Oct. 9 and are to be finished by Dec. 1, 1888. They were designed by J. D. COOK, Toledo, O., who is also Constructing Engineer. The contracts for labor and for all material excepting pipe and specials, valves and hydrants were taken by House & Taylor, Norwalk, O. All other material was furnished by the village, we buying the pipe and specials of the Lake Shore Foundry Co., Cleveland, O., the valves and hydrants of R. D. Wood & Co., Philadelphia, Pa., and the pumping machinery and boiler being furnished by the Hughs Mfg. Co., Cleveland. We expect the work will be in full operation by Dec. 15.

Our population is 1,500. The water supply is gathered in a reservoir 90 by 144 ft., by 20 ft. deep, with slopes of 2 to 1, and it comes to the village by gravity. There will be three miles of 8, 6 and 4-in. cast-iron, 150 taps, and 22 hydrants. The fire pressure will be 75, and the ordinary 100 lbs. The works will cost $15,000, of which $10,000 is paid in bonds bearing 5 per cent. interest. The trustees are: Capt. H KELLEY, JNO. COULTER and LOUIS KLINE. The former is Superintendent. H. KELLEY.

GREENSBURG, Ind., Nov. 23, 1888.

EDITOR ENGINEERING NEWS:—SAMUEL R. BULLOCK, 11 Wall St., New York City, has a franchise for water-works here. Little work has been done. J. W. CRAIG, C. E.

BURLINGTON, Wis., Nov. 19, 1888.

EDITOR ENGINEERING NEWS:—I think the village will build water-works next year to supply our population of 2,000. The supply will probably be pumped from a well to a reservoir. Estimated cost, $15,000, or less. Nothing has been done in the way of raising money to pay for works. GEO. H. WILBUR.

WASHBURNE, Wis., Nov. 22, 1888.

EDITOR ENGINEERING NEWS:—A company is just organizing to build works here under a 25 year's franchise, with forty hydrants at $75 each. It is proposed to have the works in operation Aug. 1, 1888, pumping the supply from Lake Erie to a reservoir holding 750,000 galls. The pump will have a capacity of 1,500,000 galls., and there will be four miles of pipe, D. M. MAXCY & Co.

GREENVILLE, Miss., Nov. 24, 1888.

EDITOR ENGINEERING NEWS:—The water-works for this place are about one-half completed, having been begun July 1888. They are being built by a company, with LOUIS METESSER, New Orleans, La., as Engineer. Local labor is used under direction of the company, except for pipe-laying which is being done by M. PHILBIN, Chicago. There are two compound condensing pumps, each of 1,250,000 galls. capacity, furnished by the Gordon Pump Co., and the boilers are from the Heine Safety Boiler Co. The pipe and specials are furnished by the Addyston Pipe & Steel Co., Addyston, O.

Our population is about 8,000. Water is pumped directly to the mains from artesian wells, and, if needed, from the Mississippi river. We are now putting in 5½ miles of pipe, and 60 hydrants have been located. Eventually there will be about 10 miles of pipe and 120 hydrants. The mains are of cast-iron and the services of lead and iron. LOUIS METESSER.

RECORD OF NEW WATER-WORKS CONSTRUCTION.

(Specially Communicated).

CONTINUED FROM PAGE 418.

Bismarck, Dak.—The works were put in operation in January, 1888. The engineers were Messrs. MORISON & CORTHELL, of Chicago, Ill. The contractors for masonry and foundations were Mayock & Burns; for pumping machinery and boilers, Dean Steam Pump Co.; for pipe, specials and hydrants, R. D. Wood & Co., Philadelphia, Pa.; for trenching and pipe laying, Mooney & Donaher. The Eddy valves are used. The supply is taken from the Missouri river and pumped to stone reservoirs, 220 ft., with a capacity of 1,000,000 galls. each, by a Dean pump with a daily capacity of 300,000 galls. There are 6 miles of pipe and 24 meters; the mains are of cast-iron. Cost of works, $110,000; rate of interest, 6 per cent. on bonds. The franchise is for 20 years, and the hydrant rental is $100 per annum. The works are owned by the Bismarck Water Co.; President E. H. BLY; Vice President, ALEX. MCKINCIE; Secretary, ALEX. HUGHES. Capital stock, $100,000; bonds, $100,000. The population is 35,000. (Date of special report; November 17, 1888).

Great Bend, Kan.—The works were commenced in the spring of 1887, and completed in March, 1888. They were designed by J. A. JONES, who was also Constructing Engineer. The works were built mostly by day work; Morrison Bros., of Great Bend, were the contractors for masonry, foundations and buildings. The boiler and stand-pipe were furnished by F. E. Palmer, of Kansas City, Mo., and the pipe and specials were furnished by A. Faundy, of St. Louis, Mo. The water is pumped to a stand-pipe 12 ft. diameter by 150 ft. high by a "Buffalo" pump with a daily capacity of 1,500,000 galls. There are 4¼ miles of pipe, 100 taps, 50 fire hydrants and 1 meter; the mains are of 4-in. to 10-in. cast-iron pipe, and the service pipes mostly of galvanized iron. Ordinary pressure, 60 lbs.; fire pressure, 100 lbs. Annual operating expenses, $2,000. Annual revenue; $1,500 from consumers, $2,500 from the city. The hydrant rental is $50 per hydrant per annum. The works are owned by the Great Bend Water Supply Co.; President, J. F. THOMPSON. Capital stock, $100,000; bonds, $60,000. Superintendent, W. O. MORRISON. The present population is 4,000. (Date of special report; November 12, 1888).

(TO BE CONTINUED).